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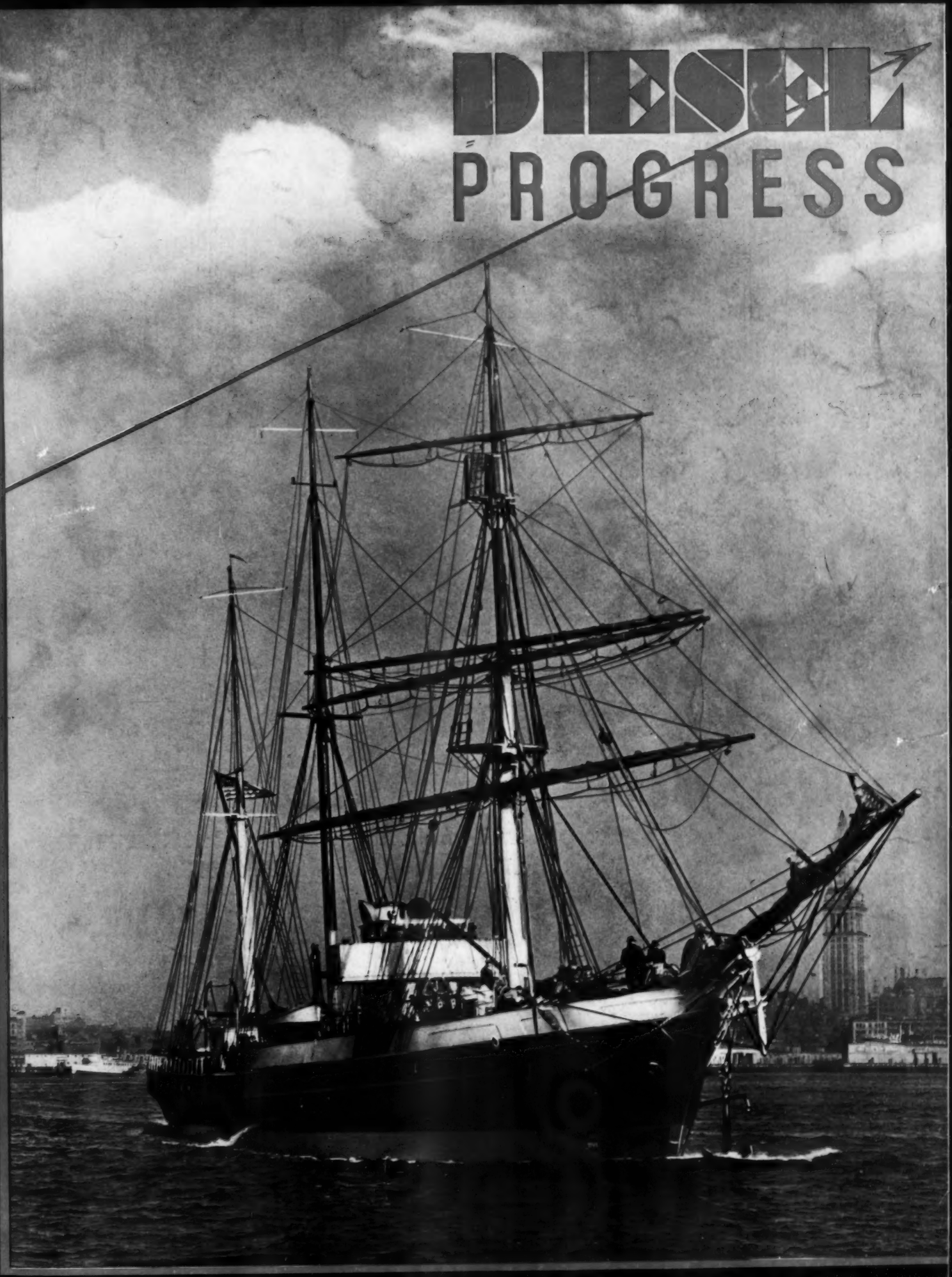
DIESEL PROGRESS



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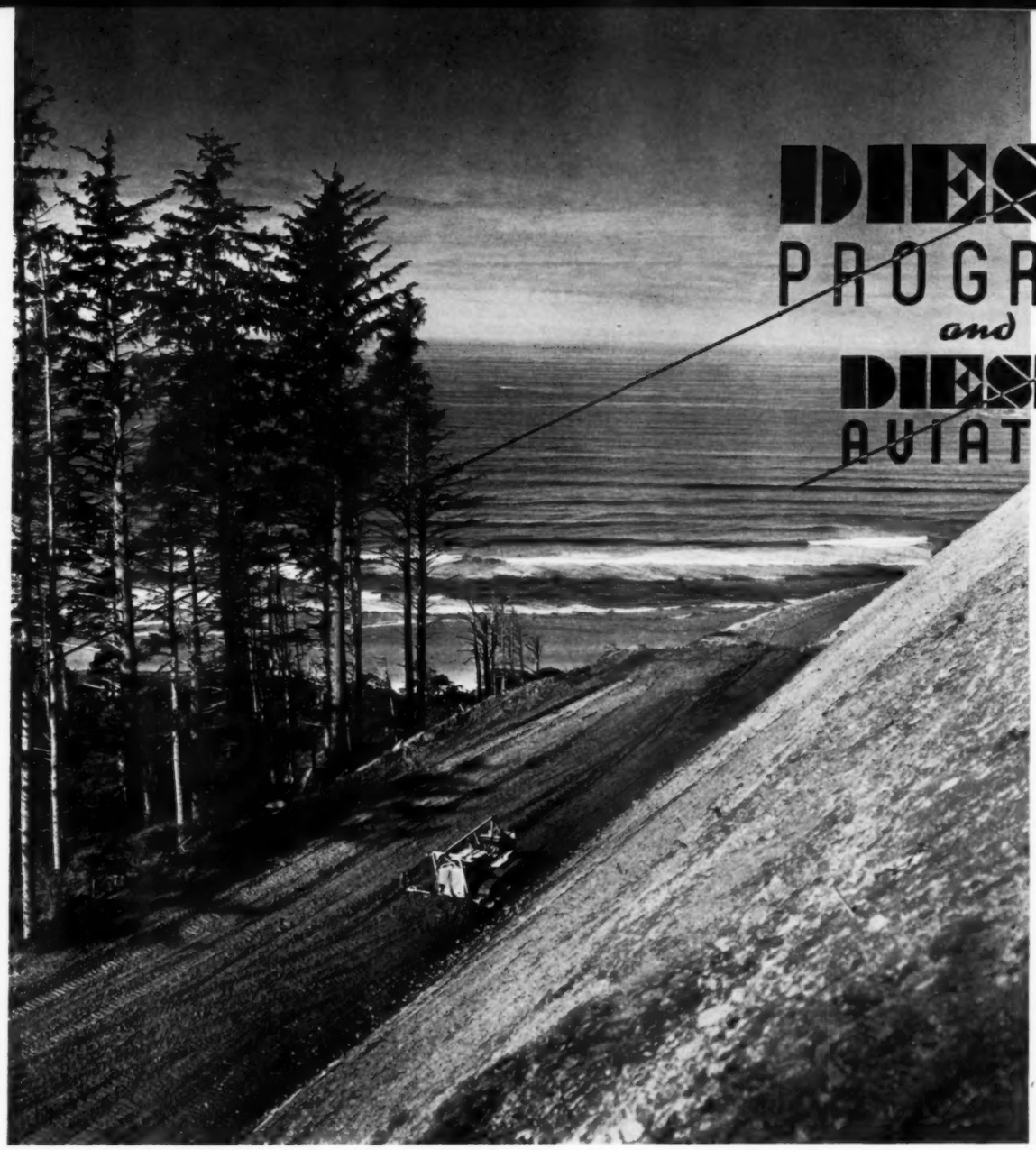

DIESEL PROGRESS and DIESEL AVIATION

REX W. WADMAN
Editor and Publisher

FRONT COVER ILLUSTRATION: The *U.S.S. Bear*, recently re-powered with an Atlas Diesel, as she pulled out of Boston Harbor for the South Pole.

TABLE OF CONTENTS ILLUSTRATION: This quiet scene typifies the splendid work which Diesel engines are doing in road building from one end of this country to the other. The Coast Highway, south of Cannon Beach, Oregon, is shown, a new piece of construction on which Caterpillar Diesels are carrying the main part of the burden.

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"LONE WOLF"
FISHER 64 DIESEL YACHT

DELIVERED at the close of the Great Lakes' yachting season to Edgar T. Wolfe of Columbus, Ohio, ardent yachtsman and past commodore of the Inter-Lake Yachting Association, *Lone Wolf* is the second of a new and distinctive type of Diesel cruising yacht developed in the past year by the Fisher Boat Works, Inc., of Detroit, Michigan.

Designed by John L. Hacker, naval architect, *Lone Wolf* is 64 ft. overall, 15 ft. beam, and 3 ft. 6 in. draft. Of substantial construction, with Port Orford cedar planking, teak decks, and mahogany houses—she is remarkable for her 23 ft. of flush after deck. Below she is a marvel of spaciousness, largely due to her successful stern engine installation—also a feature of her now well-known predecessor, *Bismillah III*, owned by Mr. George Trumbull of Detroit.

Lone Wolf's forecastle has berths for three men with separate shower and toilet rooms, followed by a completely appointed galley to port—equipped with a shipmate gas range, hot water heater, and Frigidaire refrigerator which is supplemented by a cold storage compartment in the tank room and immediately accessible to the galley. Abundant in locker space, the galley is finished in stainless steel, while opposite to starboard is a comfortable dinette whose decorative motif is curly maple and walnut, with red leather seats.

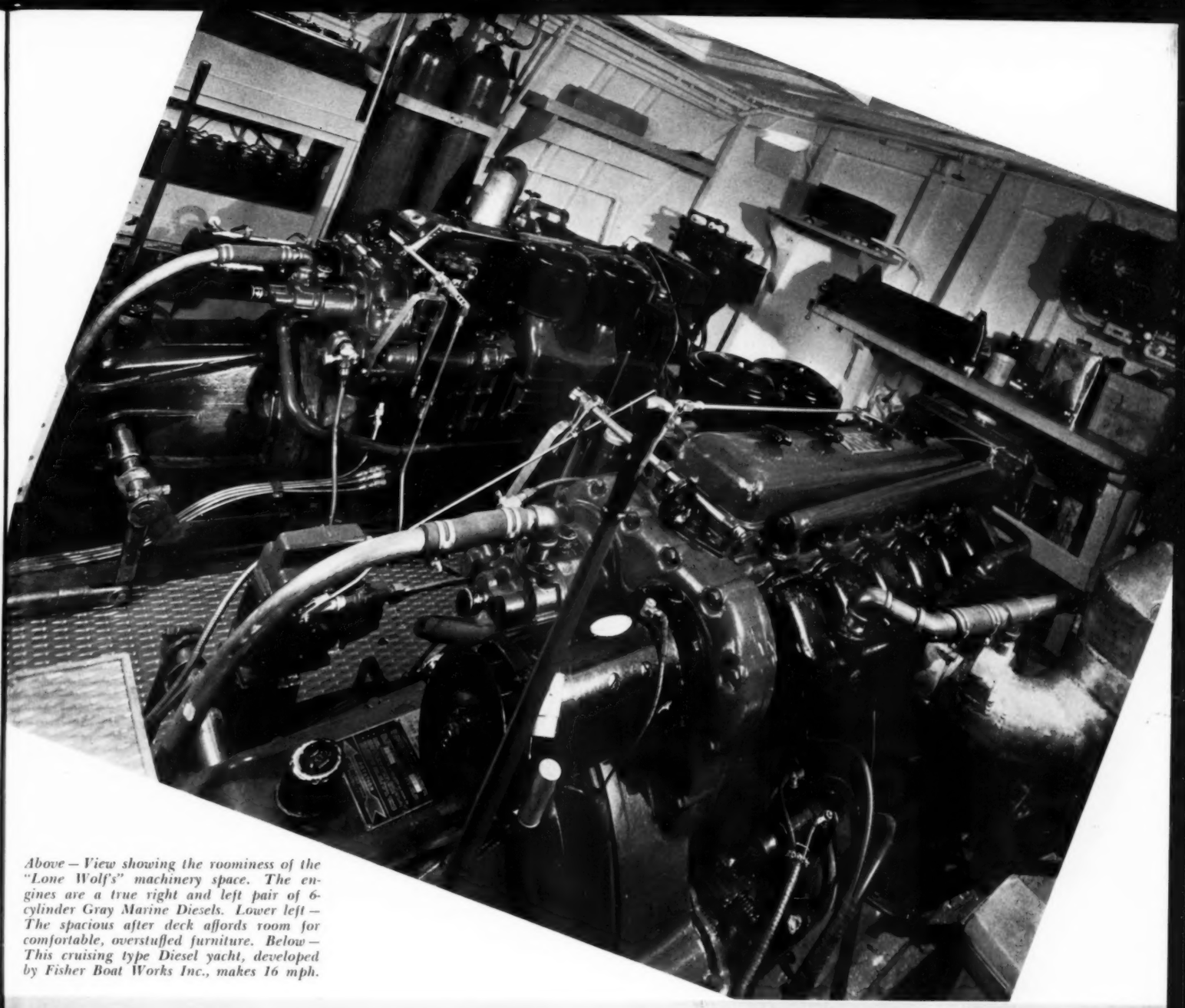
The deckhouse is finished in United States walnut plywood and has a custom-built radio and automatic record changing victrola. The windows are operated by automotive type regulators, and are screened by Venetian blinds of aluminum. The owner and his guests have at their disposal three double staterooms lighted by General Electric Lumiline fixtures. The two toilet rooms, one of which has a large shower compartment, are furnished in tileboard and have Groco electric water closets. A large storage room and gun locker complete the arrangements.

In the pilot house are the manual type "Kimball" engine controls, a Bendix automatic steerer, a General Communications Company radio direction finder and a Western Electric ship-to-shore radio telephone of 100 watt power. Large drawers and a chart table make navigational work a pleasure and there is a high leather upholstered lounging seat. Built into the pilot house and operated from the after deck is a Hammond electric organ which Commodore Wolfe plays with great skill.

In the very stern is the engine room, notable for its full head room. Here the pair of 6 cylinder, 165 hp. Gray Marine Diesels are installed. These Diesels are opposite in rotation and are direct-drive models, driving through 2:1 Capital Vee-drives, taking the reduction in the Vee drive unit. In cruising trim the *Lone Wolf* makes 16 mph. The engines are 4¼ in. bore, 5 in. stroke, equipped for fresh water cooling, electric starting, and have attached fuel and lube oil filters. The governors permit full manual control of the engines between 300 rpm. idling speed and over speed.

These engines, coupled by "Mechanics" universal joints to Capitol gear boxes, drive 29 x 25 Hyde wheels on 1¾ tobin bronze shafts at 875 rpm. through a 2 to 1 reduction at the gear boxes. The engine room floor plates are diamond tread aluminum as manufactured by the Aluminum Company of America. Electric power is furnished by a 32 volt, 750 watt generator on each motor and a separate Delco 32 volt, 800 watt generating unit for emergency use. These charge the 8 volt, 1,500 ampere hour batteries which are arranged in two banks of four each and connected in series to produce 32 volts. Auxiliary equipment consists of Skinner oil purifiers, Lux fire system, electric bilge and deck hose supply pump, General Electric tungsten charger and electric American Engineering Company winch. A gas detector by Mine Safety Appliance Company is connected with galley and engine room with bell alarm. A forced air ventilator system is installed in the owners' quarters. Sound insulation and Maxim silencers make the vessel virtually noiseless.

Captain Sam Davis, skipper, reports a successful trouble-free run of the *Lone Wolf* to Florida, where she will give her fortunate owner many pleasant hours of healthful enjoyment.



Above — View showing the roominess of the "Lone Wolf's" machinery space. The engines are a true right and left pair of 6-cylinder Gray Marine Diesels. Lower left — The spacious after deck affords room for comfortable, overstuffed furniture. Below — This cruising type Diesel yacht, developed by Fisher Boat Works Inc., makes 16 mph.

BALDWIN DIESEL-ELECTRIC SWITCHERS

By WILBUR W. YOUNG

CONFIDENCE in its products and in the future of our railroads is emphatically expressed in The Baldwin Locomotive Works' current stocking plans. With an initial investment of over $2,000,000 for facilities and stock, Baldwin recently launched on a program to build twenty-eight 1,000 hp. and 660 hp. Diesel-electric switching locomotives in line production. Several units are now under actual construction.

The present schedule calls for completion of twenty-eight locomotives for switching and transfer service, regardless of whether orders for them are received beforehand. Acting on the principle that ability to make prompt delivery is quite as essential as to build good locomotives, Baldwin will complete these twenty-eight locomotives for stock.

This new policy of The Baldwin Locomotive Works recognizes the growing acceptance of Diesel switchers among the railroads due to low operating costs and high availability. The policy anticipates a large volume of business in this class of equipment and looks towards placing Baldwin in the way of getting its share. Other types of Diesel locomotives suitable for passenger service are in the planning stage at Baldwin and we can probably look for tangible news from this source in the not too distant future.

Characteristic features of the New Baldwin 660 hp. and 1,000 hp. Diesel-electric switchers are De La Vergne Diesel prime movers, built entirely in the Baldwin shops, clear vision over and alongside the hood, safety tread steps built integrally with the frame, accessibility for inspection and maintenance through fourteen double doors in the super-structure, and accessibility of the entire electrical transmission setup through double doors in the cab. These features contribute to the safety of ground, operating and inspection crews.

The 1,000 hp. switcher weighs 124 tons, while the 660 hp. machine weighs 100 tons. Designated as types 0-4-4-0, single power plant Diesel-electric locomotives, they have two electric traction motors mounted on each truck, one motor to each axle with the weight distributed equally over each truck.

Following are some general specifications of the two locomotives:—

	1,000 hp.	*660 hp.*
Wheelbase of locomotive (total)	33′ 6″	30′ 6″
Length over couplers	48′	45′
Height from rail to top of cab (maximum)	14′ 6″	14′ 6″
Height from rail to top of engine compartment hoods	12′ 3⅛″	12′ 3⅛″
Width of cab	9′ 10″	9′ 10″
Width of engine compartment hoods (outside)	5′ 8¼″	5′ 8¼″
Maximum speed (mph.)	60	45
Fuel oil capacity	700 gals.	600 gals.
Water capacity	320 gals.	240 gals.
Lubricating oil capacity	64 gals.	55 gals.

The Westinghouse Schedule 14-EL braking equipment is served by a Gardner-Denver 3 cylinder, 2 stage air compressor, equipped with an air cooled intercooler. The air compressor is driven from the generator shaft extension through a Thomas Type D.S.M. flexible coupling.

The cab, located at the No. 2 end, while substantially built of steel plates, is literally all

glass — Saftee Glass — which gives the operator clear vision in all directions. The radiator, located at No. 1 end of the locomotive is designed to give suitable capacity for cooling both the engine jacket water and lube oil. Radiator and radiator tanks are furnished by The Young Radiator Company. Adjustable radiator shutters permit operation of the engine at correct temperature regardless of weather and service conditions.

The fuel oil tank, capacity 700 gallons for the 1,000 hp. and 600 gallons for the 660 hp. locomotive, is mounted crosswise under the main frame between the two trucks, and is amply baffled to prevent surging of the oil.

The hearts of these two new locomotives are the De La Vergne 6 cylinder, 660 hp. and 8 cylinders, 1,000 hp. Diesel engines which are otherwise essentially the same in basic design.

An exclusive De La Vergne feature of major importance is the Combustion System (Patented). The spherical water-cooled combustion chamber is cast integrally with the cylinder head, and connected with the cylinder combustion space by a throat. During the compression stroke, the air is forced into the chamber, entering tangentially at high velocity, thereby producing a vigorous turbulence. Fuel oil is sprayed into the combustion chamber through a multiple-orifice spray nozzle which has comparatively large openings.

The De La Vergne System with a controlled-turbulence combustion chamber and a multiple-opening spray nozzle permits injection of fuel over a longer period, at lower injection pressure rise per degree of crank travel, and low maximum combustion pressure. These engines are designated as Model VO, vertical four-stroke cycle solid injection, 12¾ in bore, 15½ in stroke.

The Woodward hydraulic relay type governor is gear-driven from the camshaft. Fuel injection is handled by an American Bosch unit system with spring loaded needle type spray valves and multihole nozzles. An Alnor pyrometer, round type, is mounted on the engine.

The engine is started by motoring the generator, using current from the 56 cell Philco storage battery which is also used for stand-by lighting.

The main D.C. 1,200 amp. generator, the auxiliary generator, traction motors and all electrical transmission are Westinghouse. The traction motors are rated at 560 amperes on the 1,000 hp. locomotive and 470 amperes on the 660 hp. locomotive.

Performance data on these locomotives are given as follows:

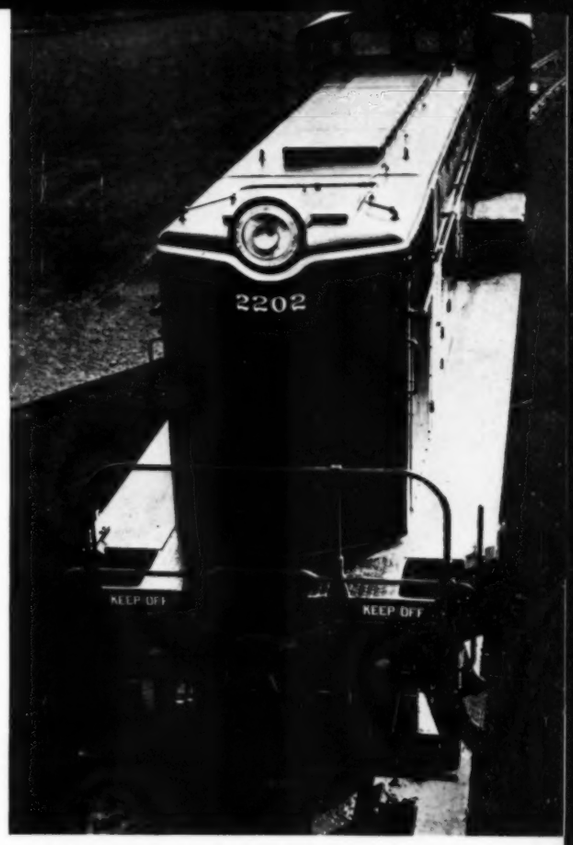
Hourly rating 44,500 pounds (660 hp.-40,000#) tractive effort, based upon 0 degrees Centigrade initial temperature of traction motors.

Continuous rating 33,600 pounds (660 hp.-28,000#) tractive effort at 8.3 mph. (660 hp.-6.5 mph.).

Tractive efforts below 33,600 pounds (660 hp.-28,000#) can be developed continuously at increased speeds.

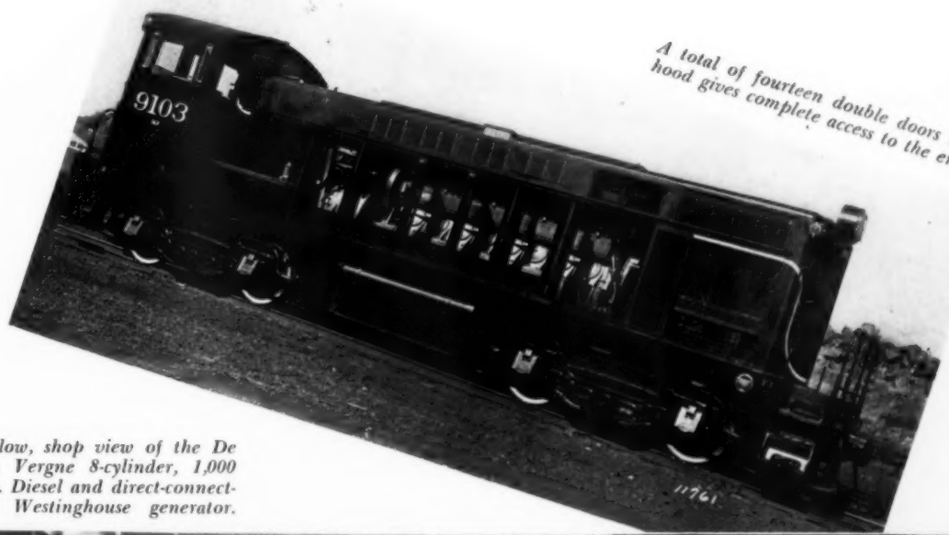
Tractive efforts above 33,600 pounds (660 hp.-28,000#) can be developed for shorter periods of time, depending upon the initial temperature of the traction motors.

The Baldwin Locomotive Company has drawn on its many years of locomotive building experience in the design and construction of these Diesel switchers. Some of the new machines are already meeting the demands of modern yard conditions in actual service.

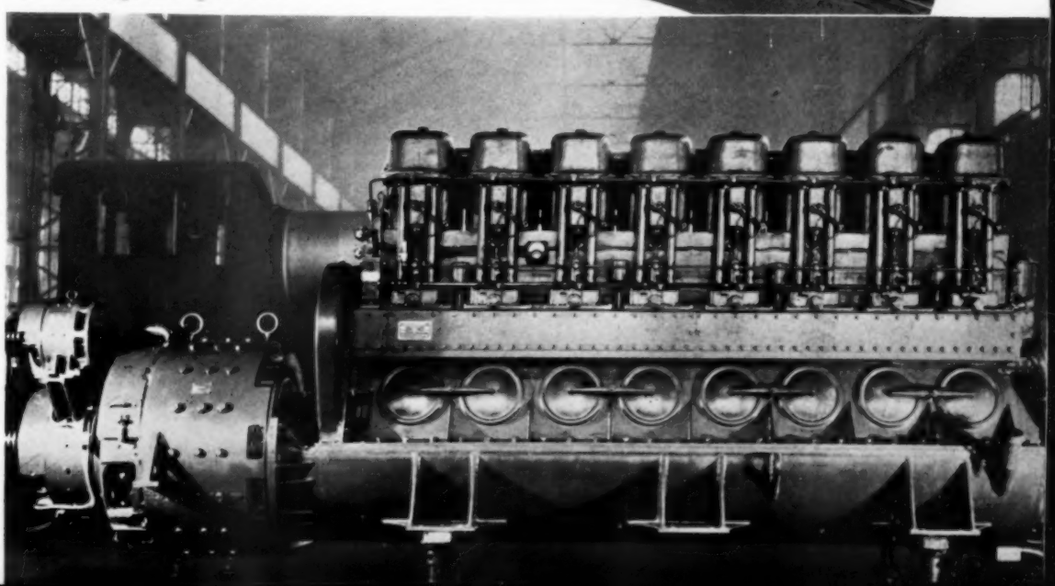


This view clearly shows the visibility from cab over the engine hood, also deep safety tread steps and platforms, and wide catwalk along both sides of the engine space.

A total of fourteen double doors in the hood gives complete access to the engine.



Below, shop view of the De La Vergne 8-cylinder, 1,000 hp. Diesel and direct-connected Westinghouse generator.



DIESEL YACHT "INNISFAIL"

By DWIGHT ROBISON

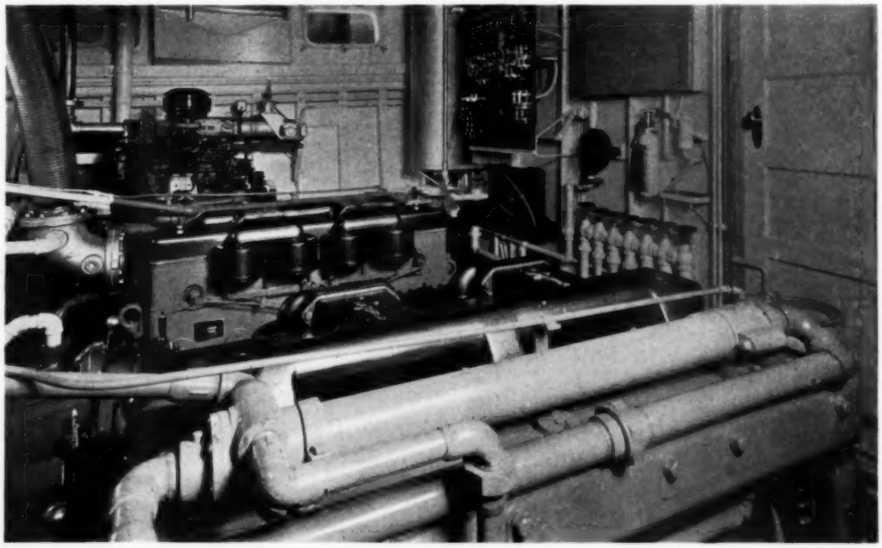
BUILT to replace the former *Innisfail* which was destroyed at New Bedford, Mass., in the hurricane of September, 1938, the present Diesel yacht *Innisfail* was delivered to her owner, Joseph M. Cudahay, last September 15 by Mathis Yacht Building Corporation. The yacht in appearance and construction stands for her owner's confidence in Mathis reputation for sound design and integrity of materials and workmanship. Happily combined in this new *Innisfail* are the pleasing lines of a large ocean going yacht with the roominess and comforts of home-like quarters for all. Her length is 90 ft. overall, 81 ft. at the waterline, and her beam is 18 ft.

The main propulsion engines are a pair of Superior Model MRD-6, 5½ in. bore by 7 in. stroke Diesels, each developing 170 hp. at 1,500 rpm. Driving two Hyde 33-32, three-blade propellers through a Joe's 2:1 reduction gear, a speed of 14.4 mph., with the engines turning 1,400 rpm., was attained in trials. With the engines turning 1,200 rpm., the speed was 13.5 mph. The 100 per cent reverse gear is also a Joe's. The main engines are equipped with engine room control. They have Leece-Neville electric starting motors, Pierce governors, bulkhead mounted Reliance tachometers, Purolator lube and oil filters and Burgess intake filters and silencers. Exhaust connections are Pennsylvania air-jacketed flexible metallic tubing. The closed fresh water engine cooling system is equipped with a Groco heat exchanger while the lube oil cooler is also a Groco, supplied by the Gross Mechanical Laboratories. A Buda, Model DG186, 3⅝ in. bore by 4½ in. stroke, 4-cylinder Diesel-electric generator set of 7½ kw. capacity, a Smith-Meeker switchboard and a 56 cell Exide Ironclad battery complete the essential engine room equipment. Typical of Mathis design, the engine room is light, well-ventilated with headroom and space sufficient for the crew to move about freely.

Engine room view looking to starboard. Note Reliance Tachometers on bulkhead, upper right.

The "Innisfail" combines pleasing yacht lines with houseboat roominess and comfort.

Domestic fresh water is circulated by Burk's pumps. Domestic hot water is heated in the water back of the Shipmate galley range. The hot water heating system is equipped with a Ray oil burner. The bilge pump is a self-priming Gorman-Rupp centrifugal type. The *Innisfail* is built of selected oak beams and framing, bronze fastened with long leaf yellow pine planking, bronze screw fastened. The deck is teak as are the deck houses and trim. Deck fittings are stainless steel, chromium plated. Simplicity and good taste are the distinguishing features of the interior trim and appointments. All interior trim is mahogany. Unusual light and air are noticeable in all quarters by virtue of 11" x 22" rectangular ports of the sliding type, an exclusive Mathis feature.



View to port side of engine room.

Owners' and guests' quarters are exceptionally roomy and provide space for rich, comfortable, home-like furnishings. The crew, consisting of captain and five men, are housed in large comfortable quarters forward.

The *Innisfail* carries an 18 ft. owner's launch, powered by a Gray marine engine, and two dinghies. Fuel storage handles 1,200 gallons and the fresh water capacity is 1,300 gallons. Her cruising radius is estimated at 1,400 miles.

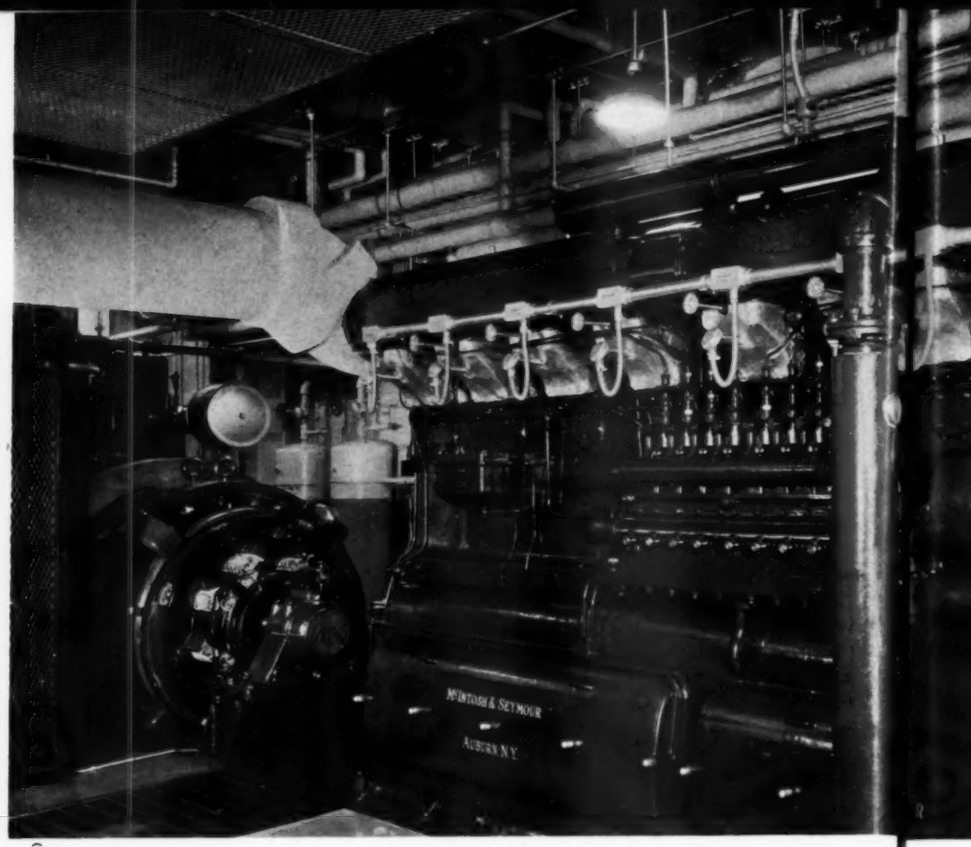
While the home port of the *Innisfail* is Lake Forest, Ill., she may never see home because she is destined to spend the winter months in Florida waters and the summer cruising along the East Coast.

The spacious afterdeck of the "Innisfail."

The homelike main deck house looking aft.

DIESELS FOR 100% EMERGENCY

By WILBUR W. YOUNG



WHEN Mount Sinai Hospital, New York, sought relief from periodic power failures, caused by street water entering the engine and boiler rooms occasioned by the bursting of large water mains, and a 100 per cent dependable source of power, its engineering counsellors, Messrs. Kaiser, Muller and Davies, in collaboration with the hospital engineering department, recommended Diesels. The result was the recently completed installation of two Alco type, 8 cylinder, 500 hp. Diesel engines direct connected to two Crocker-Wheeler 350 kw. D.C. generators with all of the accessories necessary to make this a self-sufficient power plant. And then to make doubly sure against failure of the power source, a three-foot flood wall was built around the entire Diesel plant.

These two McIntosh & Seymour engines, built by American Locomotive Company, are designated as Alco type Diesels and are identical. They are 4 cycle, solid injection, 8 cylinder, 12½ in. bore and 13 in. stroke, and develop 500 hp. at 400 rpm. This Alco type Diesel is designed for universal application, including marine, railroad and stationary. The design also includes provision for conversion to gas fuel.

A Woodward variable speed, type SI, governor is installed on each engine. Piston rings are American Hammered. Fuel, lube oil, and cooling water pumps are built-in, as is the Alco-manufactured combination Cuno and Bosch final fuel filters. The fuel injection system is American Bosch. Weston thermometers are used throughout the cooling and lube oil systems. The gauge board carries the following U. S. pressure gauges: two lube oil manifold, two fuel oil injection manifold, two engine water, two lube oil pump, two fuel oil pump, two lube oil cooler, and two compressed air.

Two Briggs Clarifiers, one with a transfer pump, the other on the engine lube oil circulating pump, handle continuous lube oil reclamation. Starting air is supplied by a Gardner-Denver 4½" x 3½" compressor V-belted to a 3 hp. Crocker-Wheeler motor. A Viking alarm system gives warning with horn and lights of abnormal lube oil pressure and cooling water temperature. Nugent twin filters in each supply line serve the injection pumps with clear fuel oil. Yale chain block trolley hoists serve each engine from an overhead I-beam.

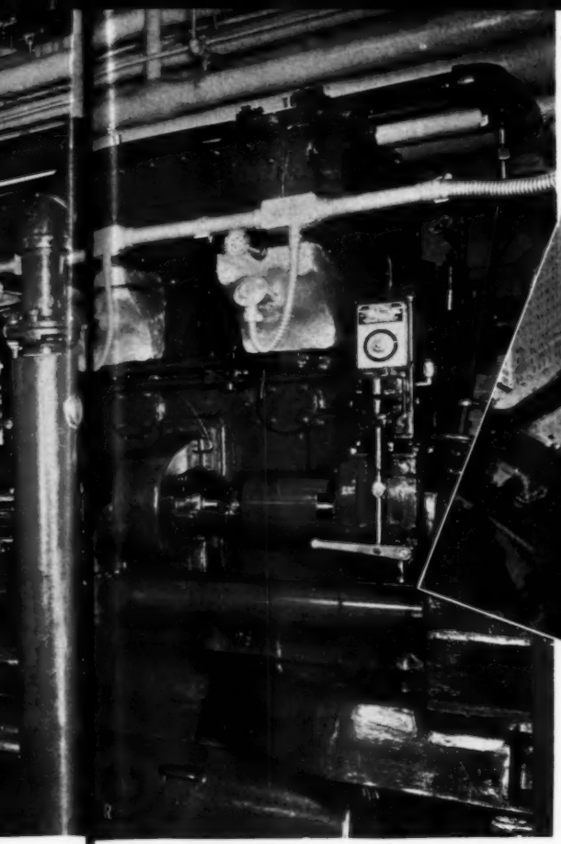
Main fuel oil supply is from a 16,000 gallon storage tank located in a concrete vault under the central courtyard. The fuel oil is transferred from storage by two rotary pumps.

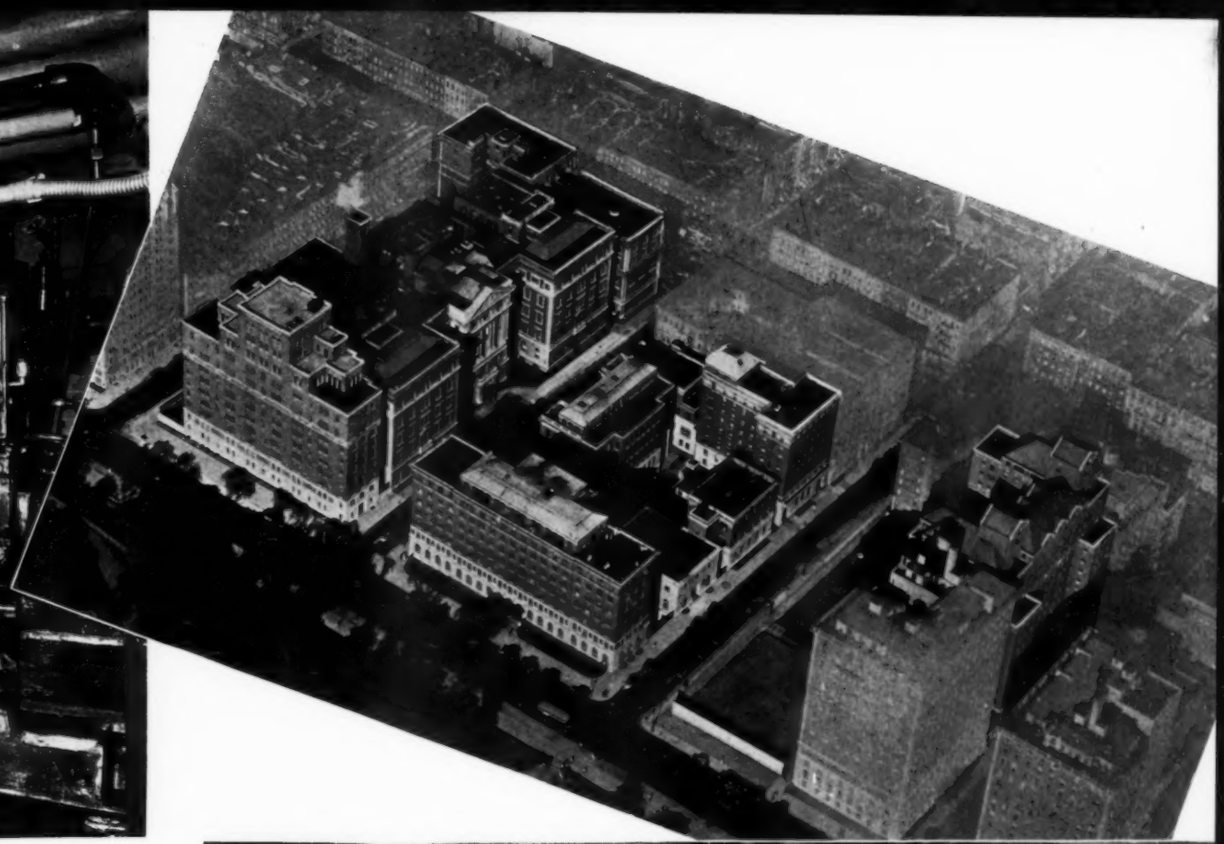
To install this plant in the basement of the central and largest unit of the hospital required that all sound and vibration be definitely handled. Burgess intake silencers and filters are mounted at each end of the intake manifolds and exhaust Snubbers of the same make, one mounted in the boiler stack, the other in an areaway were the engineers' choice for noise treatment. Each of the fabricated steel engine bases rests on forty-two rubber pads, carrying a total of 152,000 lbs. These pads were supplied by Manhattan Rubber Company.

In the interest of saving space, as well as to keep all equipment within the protecting wall, the engine isolation pit was made wider than usual and in this area, under the floor grating, are installed the starting air compressor, and Davis jacket water and lube oil coolers. The heat extracted from the engine jacket water is made available for domestic hot water used throughout the hospital.

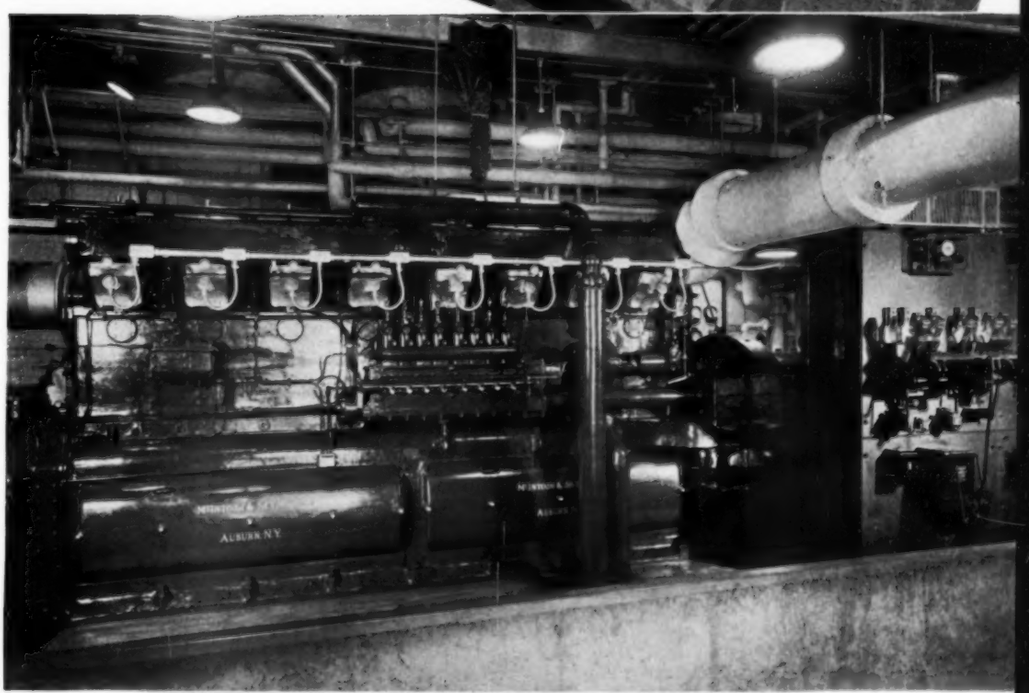
The engines are operating on Texas Ursa lube oil and Socony Diesel fuel oil. Fuel consumption is running at 13.0 kw. per gallon which is expected to improve a few points as the load distribution improves.

The two switchboards were built by the Cole Electric Products Company and are fitted with I.T.E. remote control circuit breakers which can be operated either from the panel at the generators or from the main switchboard by a special type of pull switch. The generator field rheostats are also remote controlled.





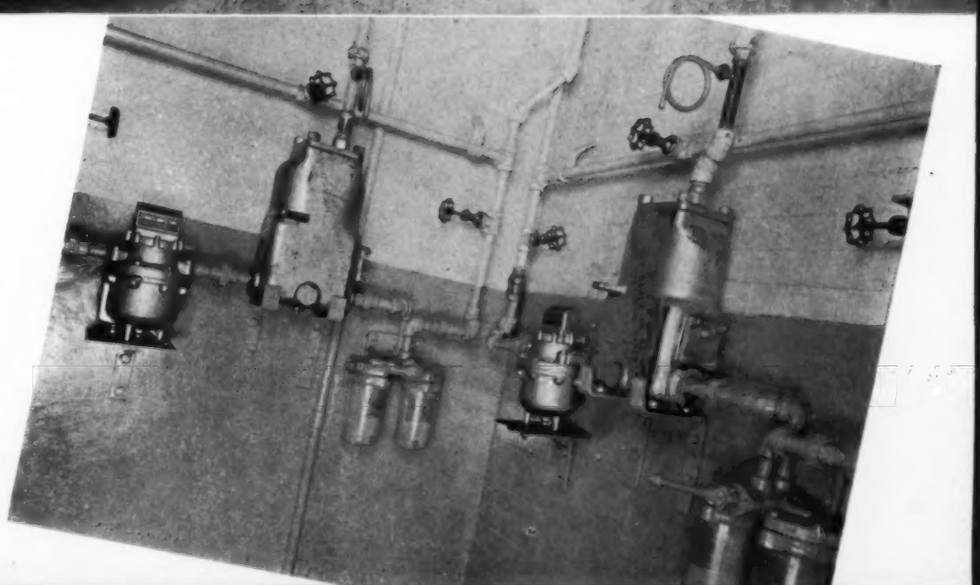
Above left: Engine room view showing injection side of one of the two Alco Diesels and one of the two Crocker-Wheeler generators. Above right: General view of Mount Sinai Hospital taken by Fairchild Aerial Surveys, Inc. Right: Another engine room view; note, one of the two Yale overhead trolley hoists. Below: View showing the Nugent twin fuel oil filters and Bowser meters.



While two steam driven generating units are retained to derive the benefit of exhaust steam for heating, one Diesel is kept on the line at all times and both Diesels will be operated when heat is not required. The Diesel plant was designed for full emergency service on the theory that light and power are paramount to heat.

The average day demand is 450 to 500 kw. with momentary demands running up to 750 kw. due to the elevator load and cloudy conditions. Night load runs from 250 to 300 kw. The total yearly power consumption is estimated at 2,500,000 to 2,700,000 kw. with the Diesels taking 60 to 65 per cent of that total.

In addition to having, in this Diesel plant, insurance against failure from all previously experienced causes, Mount Sinai Hospital is already realizing savings of power cost at the rate of $18,000 per year, directly creditable to the new Diesel engines. With certain other changes, mainly in switching from steam-driven to electric-driven pumps, compressors, etc., the hospital is assured of savings totalling $20,000 to $25,000 per year. And this has been accomplished with no increase in personnel.



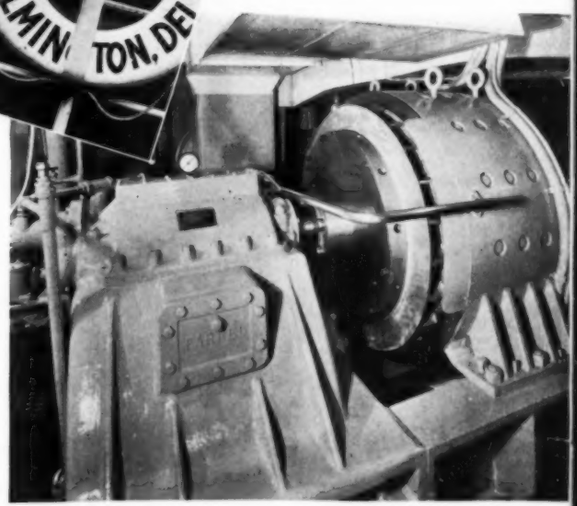
Looking down on the 950 hp. General Motors 12-cylinder, V-Type Diesel engine, as installed on the "Raymond Card."

Looking toward the generator end of the 950 hp. General Motors 12-cylinder main engine. Note the 3-cylinder, 45 hp. General Motors auxiliary engine on the right.

The "Raymond Card," a 95' x 22' x 10' 4" welded steel tugboat designed by George Drake and built by the Gulfport Boiler & Welding Works, Port Arthur, Texas.

Reading from left to right — Henry W. Card, William Card, and Edward L. Card of the Card Towing Line, Inc., proud owners of the "Raymond Card."

Close-up of the propulsion motor and the Farrel-Birmingham reduction gear on the "Raymond Card."



TUG "RAYMOND CARD"

Blazes a New Trail in Diesel-Electric Drive

By REX W. WADMAN

THE Battery, New York, December 11th. In the shadow of New York's old Aquarium lay the *Raymond Card* this afternoon — "open for inspection," as the invitations to the press and the trade read. And well worth inspection, for, once again, General Motors and George Codrington break with precedent and start plowing a new furrow of their own.

The *Raymond Card* is the first Diesel-electric vessel ever to be built with *all* the propelling machinery manufactured by one company, with one guarantee, with one responsibility. General Motors Corporation built not only the main and auxiliary Diesel engines, but also the main generator and the electric propulsion engine. This is the first time a towboat operator has been able to buy a boat with electric drive with *all* the propulsion machinery constructed by one builder and Card Towing Line, Inc., was quick to see the possibilities of this much desired combination.

General Motors' George Codrington, in taking me around the boat here this afternoon, said, "For ten years we have consistently advocated the desirability of concentrating full responsibility in the power of modern work boats with one competent company. Experience proves," said Mr. Codrington, "that a marine power plant should be considered as a unit, and not as an assembly of unrelated parts. Such a policy not only saves much time and money, but it also greatly widens the possibilities of producing a power plant which will operate more smoothly and efficiently, as well as simplifying and expediting service. In short, the plan permits a nearer approach to maximum efficiency in operation with minimum idle time for service and repairs."

Full of enthusiasm and proud of his achievement in once again turning one of his pet dreams into a practical reality, Mr. Codrington praised the splendid workmanship of the Gulfport Boiler & Welding Works of Port Arthur, Texas, who built the *Raymond Card*, then he took time out to say a few cogent words about the artistry of George Drake who designed the vessel. She is a splendid example of the new Lincoln-Weld technique. They know how to weld ships down there on the Gulf Coast.

In detail — the *Raymond Card* is 95' x 22' x 10'4" all-steel welded towboat powered with a Model 12-567 General Motors twelve cylinder V-type, two cycle 950 hp. 8½" x 10" 750 rpm. Diesel engine driving a 615 kw. 600 volt General Motors main generator which is separately excited by a 24 kw. V-belt-driven exciter rated 950/1,900 rpm. 125 volts D.C. Generator contains special built-in starting winding arranged for cranking the main engine from a 65 volt D.C. starting battery. General Motors also built the electric propulsion motor which delivers 750 shp. at full load, 600/750 rpm., 600 volts, D.C. The Farrel-Birmingham reduction gear unit is rated at 750 shp. and shaft rpm. of 160/200.

The auxiliary engine is model 3-71 General Motors Diesel, a three cylinder 45 hp. two cycle unit driving a General Motors 30 kw. generator at 1,200 rpm. An unusually compact, quiet-running machine.

The outstanding accessories aboard consist of a Maxim Spark Arrester type silencer for the main engine and a Burgess Snubber on the exhaust of the auxiliary unit. Harrison heat exchangers for all services. A Briggs Clarifier satisfactorily handles the purification of the lube oil. A Chisholm-Moore Hercules hoist services both engines. Exide batteries supply ample current for starting both main and auxiliary machines plus standby electric requirements.

There is Jones-Motrola tachometer on the 950 hp. General Motors Diesel and an Allis-Chalmers Tachometer on the bridge deck. Allis-Chalmers likewise supplied the control panel and switchboard in the engine room. The Radiomarine Corp. installed in the ship-to-shore and ship-to-ship telephone set and Benson Electric supplied the electric steermotor.

ATLAS-LANOVA DIESEL INSTALLATION

By WILL H. FULLERTON

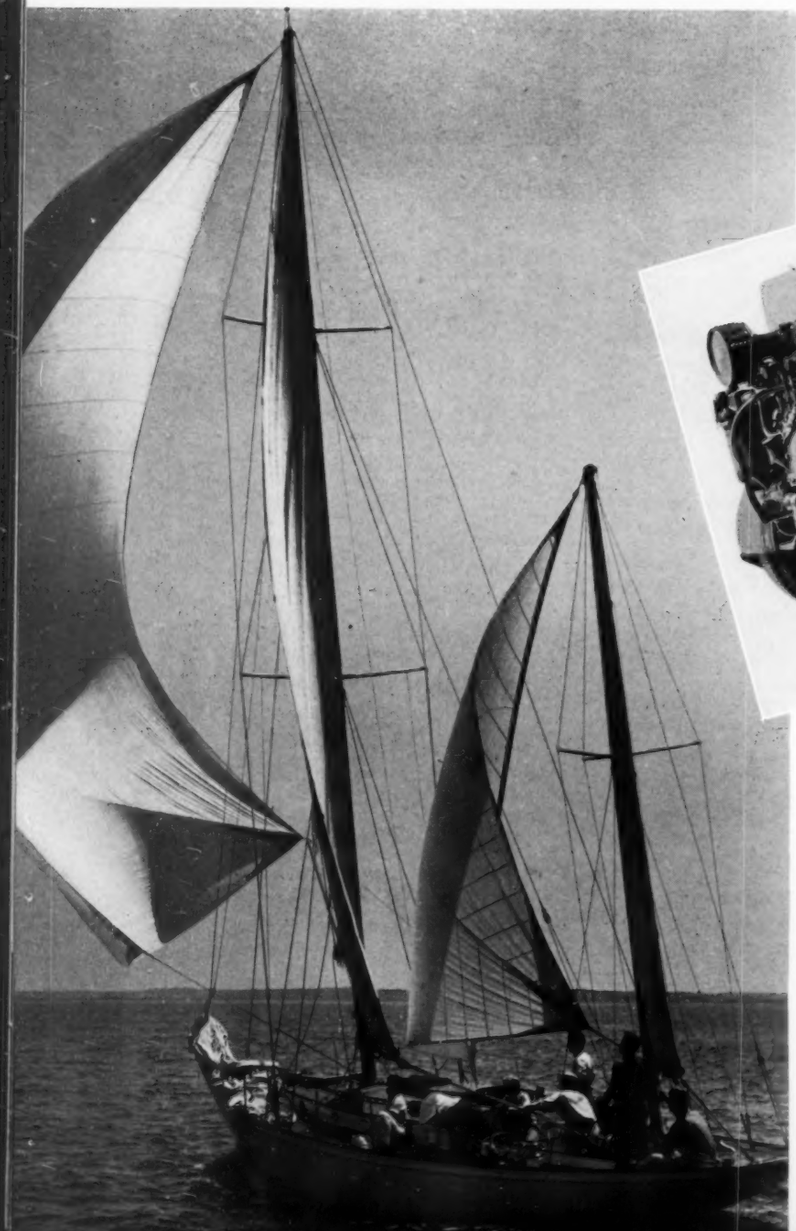
THE latest addition to the Atlas Imperial line of Diesel engines, which will have its premiere showing at the 1940 Motorboat Show, will be a three cylinder marine engine. Duplicates of this engine have been purchased by the U. S. Navy for installation in the three new cruising yawls delivered last spring to the United States Naval Academy. This unit is the smallest Diesel engine to employ the Lanova combustion system and will be installed in the *Intrepid, Alert* and *Resolute* previous to the 1940 yachting season to supply auxiliary power. These three boats, delivered by Luders Marine Construction Co. last spring, were completely described editorially in the July issue of DIESEL PROGRESS. They are known as Naval Academy 30 Footers, with principal dimensions as follows:

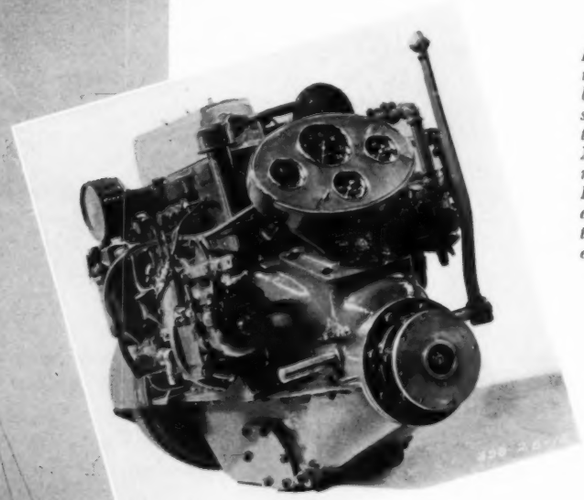
L.o.a. 44 ft., L.w.l. 33 ft., Beam 11 ft., Draft 6 ft., Displacement 23,400 lbs., Sail area 870 sq. ft. Although designed primarily for Chesapeake Bay, they have sufficient ruggedness to qualify for ocean racing under the requirements of the Cruising Club of America.

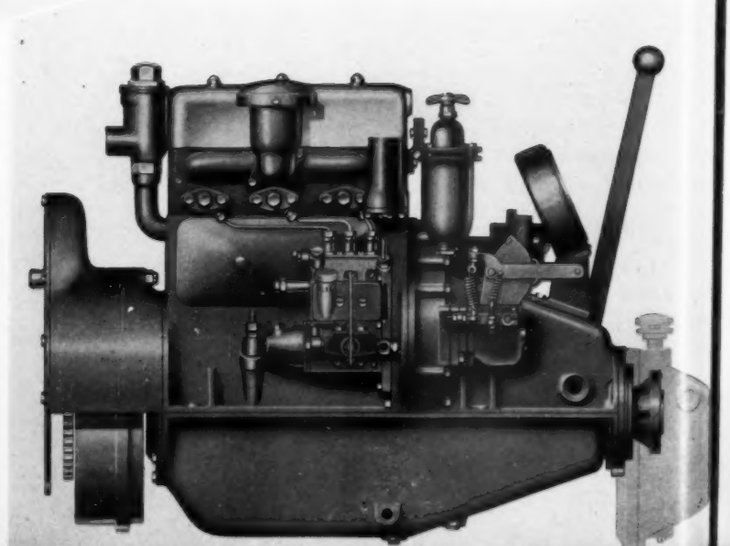
The new Atlas-Lanova engine, as supplied for installation in these craft, is now available for similar yachting service. It is a 3 cylinder, 4 cycle, solid injection, full Diesel with a bore of 3⅛ in. and a stroke of 3¾ in. It is rated at 16½ hp. at 2,000 rpm. and is particularly suitable for relatively small boat operation because of its remarkably small size.

Although engine size has been reduced to meet an over-increasing demand by small boat owners for a full Diesel propulsion plant, this new unit retains all of the rugged dependability of the well-known Atlas Imperial heavy-duty line. Cylinders are cast enbloc and are fitted with removable liners. American Bosch nozzles are fitted to each cylinder. American Bosch fuel injection system is used which delivers fuel oil to each cylinder at predetermined pressure.

Size alone will make this unit one of the most interesting at the show, since it has been designed and produced primarily to satisfy the many demands of small boat owners for Diesel propulsion.







Extreme left — One of the three new U.S. Naval Academy Yawls, built by Luders Marine Construction Co., to be powered by the new Atlas-Lanova Diesel. Next left — Operating end of the new Atlas-Lanova 3 cylinder Diesel which develops 16½ hp. at 2,000 rpm. Below — View of the injection side of the same engine.

MORE ON TORQUE CONVERTERS

By REX W. WADMAN

DAVENPORT, Iowa, December 15, 1939.—Here today, in the yards of the Rock Island Railroad, was demonstrated another successful application of fluid or hydraulic drive to switching locomotives. As the illustration on this page and the following pages brings out clearly, this new Hydro-Motive General Machinery Corporation switching locomotive is a 44-ton swivel truck type built by the Davenport Locomotive Works and powered with a Hamilton Diesel engine, 8¾" x 12", 4-cycle, rated at 400 hp. at 900 rpm., which is direct-connected to a hydraulic transmission drive using the Schneider torque converter. In the September issue of DIESEL PROGRESS, on pages 19 through 21, I described in some detail the first application of the Schneider hydraulic transmission to switching locomotive service. In this case the locomotive itself was a 70-ton, rigid wheel base side-rod type. This article in our September issue created considerable attention, especially among our railroad executive readers, many of whom wrote to me for additional information or asked specific questions. Therefore, later on in this article I am going to discuss in some detail "what makes the machine go 'round" in this Schneider Hydro Transmission, but before I do that I want to describe briefly this 44-ton job which was demonstrated so successfully here at Davenport today.

Technically, this compact little switcher is a 44-ton Diesel hydraulic drive locomotive of the 0-4-4-0 type, 56½ in. gauge, has four pair of driving wheels 44 in. in diameter, and two swivel power trucks. The height-above-rail at center of cab is 14 ft. 2 in., length over couplers 35 ft., width overall 10 ft. 8 in., with the radius of the sharpest curve 50 ft.; total weight 89,750

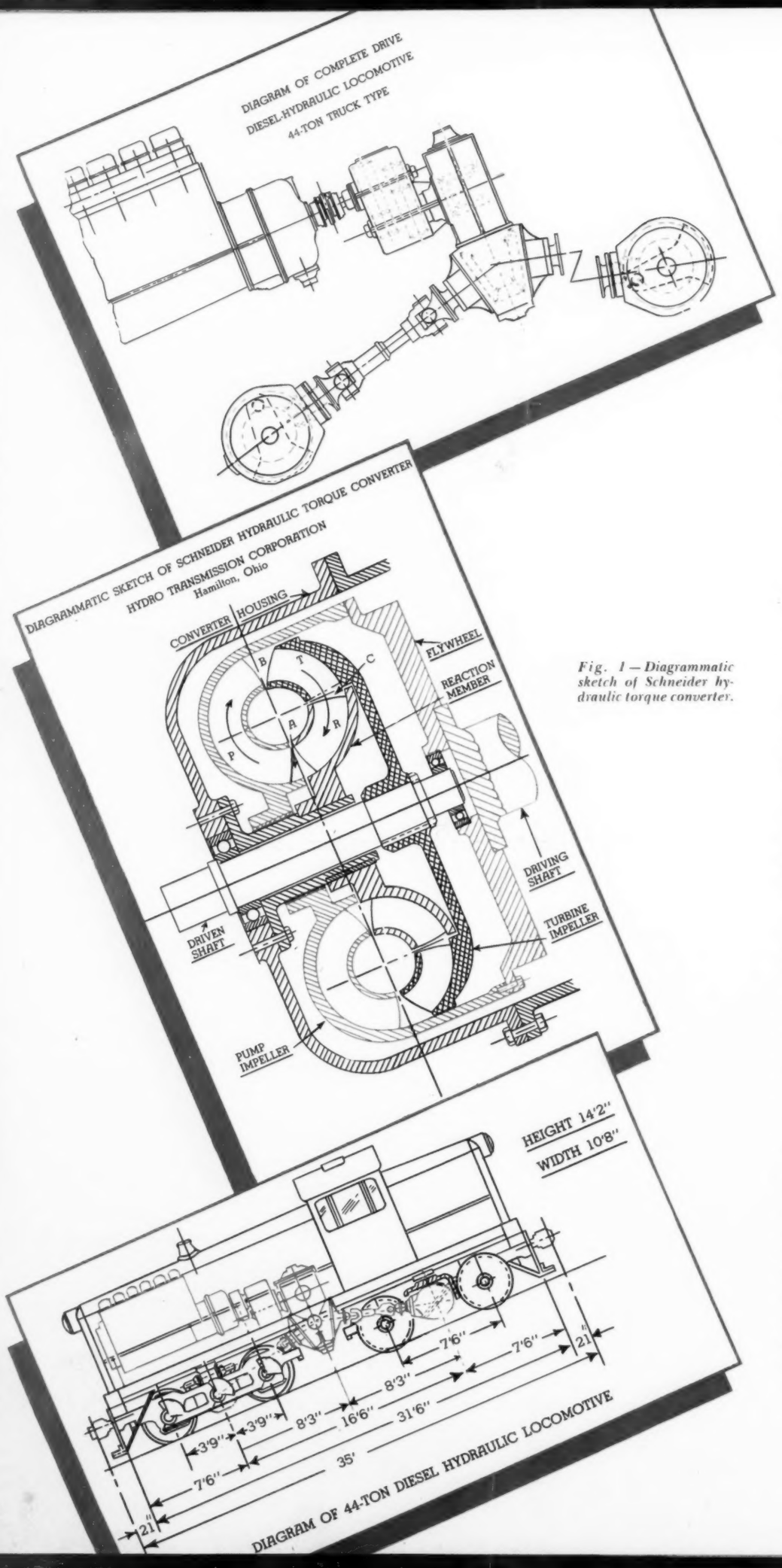


Fig. 1 — Diagrammatic sketch of Schneider hydraulic torque converter.

lbs., weight on drivers 89,750 lbs., tractive effort 22,000-29,333 lbs. Maximum speed is a "low" of ten miles to a "high" of forty miles.

The power plant was built by the Hooven, Owens, Rentschler Division of General Machinery Corporation, Hamilton, Ohio, and is the same type and size as installed in the 70-ton locomotive described in our September issue. The hydraulic drive, consisting of a Schneider hydraulic torque converter, two-speed pressure-operated gearbox and truck jackshaft, was made by the Hydro Transmission Corporation of Hamilton, Ohio. The locomotive chassis, cab, hoods, etc., were made by the Davenport Locomotive Works here in Davenport.

The top speed of the locomotive in high gear is 40 mph. and in low gear 10 mph., using gear ratio of 4:1. The range is the same in reverse as in forward. The hydraulic transmission provides an infinitely variable torque and speed ratio, automatically changing according to load. With no clutch and only two gear sets, shifting to either "high" or "low" is performed hydraulically by a small lever on a shifting valve at the operator's control stand.

Simplicity in design means less maintenance and an all-around more economical unit. Repairs and replacements are minimized and all work that may later be required can be effected with less time and expense, because of the simplicity and accessibility. The torque converter has only two moving parts and the further advantage of running in a continual bath of oil with sufficient clearance between the revolving parts to avoid wear.

Due to the fact that there is no mechanical connection between the engine and the transmission, road shocks are not transmitted to the engine or vice versa, thereby protecting both engine and drive mechanisms. This gives smooth, shockless performance to the whole locomotive not only relieving the operator but making it impossible for the operator to abuse either the engine or transmission.

A further advantage is found in the fact that a big load can be moved because full engine power can be delivered with such smoothness at starting. The Diesel engine can be brought up to full speed to start, and the variance between the engine speed and the torque converter being smoothly taken up as the load is brought up to speed. This makes it impossible to overload the Diesel engine whether the locomotive moves or not. Since there are no mechanical connections between the engine and the wheels, nothing can be damaged when the locomotive is overloaded.

The torque converter delivers an increase in torque from maximum speed to low speed and stalling, sufficient to handle all loads for which it is designed under any operating condition. The selective two-speed gearbox, hydraulically operated, affords a further increase of the maximum torque of two to five times, enabling the locomotive to move and accelerate an extreme load.

The problem of maintenance on the hydraulic torque converter is practically eliminated due to the fact that no moving parts come in contact with each other, with the exception of the shafting, and bearings, which are anti-friction bearings requiring little or no attention. The two-speed gearbox consists essentially of gears, clutches, and anti-friction bearings. The gears, of conservative design, are well lubricated and require no attention, since alignment cannot change due to the use of anti-friction bearings. The clutch wear is very small because the clutches are protected by the hydraulic torque converter. As most of the slip during engagement is taken up by the converter, quick-gripping type clutches are permitted. They, furthermore, run in oil and do not engage in jaws, and are of ample size to withstand any demand made of them.

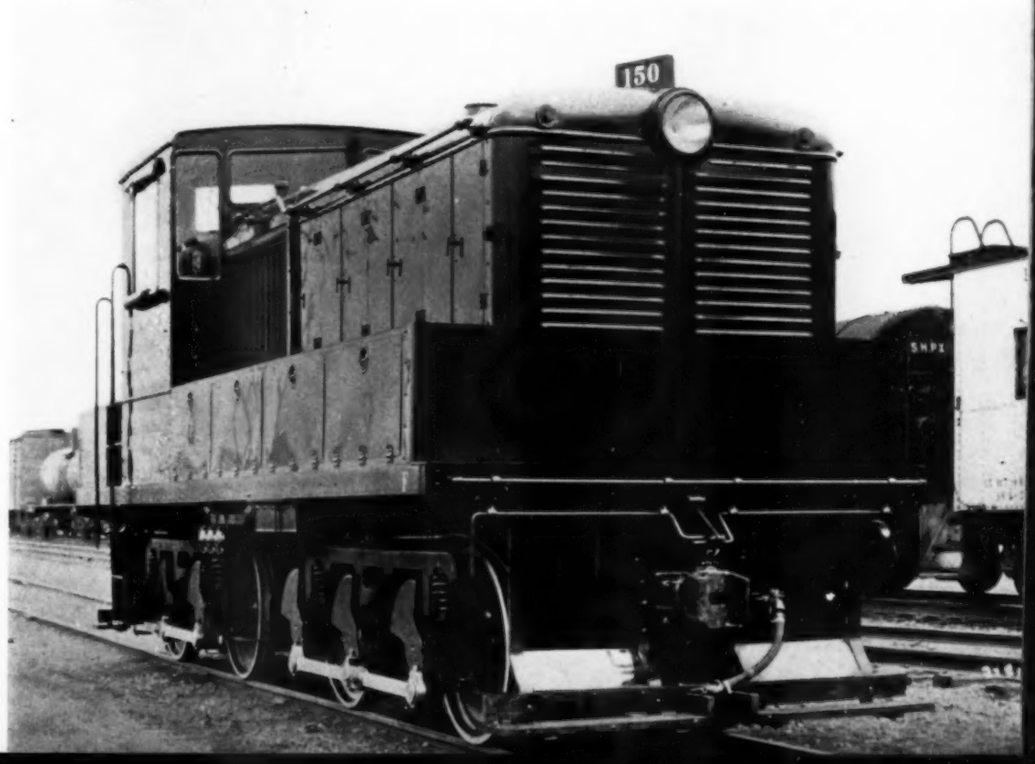
Now to get down to design details — the Schneider hydraulic torque converter consists essentially of three parts: (1) the centrifugal pump impeller, attached to and driven by the Diesel engine flywheel, (2) the turbine, attached to the drive shaft of the locomotive, (3) torque increase apparatus which does not rotate and is attached to the outside casing of the torque converter. The housing of the torque converter is bolted directly to the Diesel engine housing. There is about 1/8 in. clearance between the rotating wheels and the stationary parts. These rotating wheels are carried on ball bearings and lubricated with the converter oil. This torque converter works on the turbo-hydraulic principle. It is a combination of a pump on the driving side, with a turbine on the driven side. The diagrammatic sketch (Fig. 1) shows the working of this unit.

Pump P and Turbine T are combined with a third bladed stationary wheel, the reaction Member R, to form a closed circuit in which the operating fluid circulates continuously in the direction indicated by the arrows and thus serves as the medium of power transfer. During the operation, the pump picks up the operating fluid, as shown, at gap A, between pump and reaction member, and carries it to gap B, at the same time giving up all its power to the fluid and converting it into hydraulic energy (partially pressure energy, partially whirl energy). From B the fluid flows through the turbine T to gap C. In this turbine, its hydraulic energy is converted back into mechanical energy which is then let out of the transmission through the driven shaft. Thus the power which comes into the transmission through the driving shaft and the pump comes back out again at the driven shaft. From gap C the reaction member returns the flow to its original state at A.

By a long process of development of the blading and other design features of the three cooperating wheels making up the circuit, special shapes have been found which, for any constant pump speed permits the energy conversion in the turbine to take place within the operating range at high efficiency, regardless of its speed, whereas the power necessary to drive the pump will not change materially. This means that in connection with a prime mover the transmission will, within the operating range, and at any fixed prime mover speed, take only a certain amount of load, with the danger of overloading the prime mover completely eliminated. Since, furthermore, there is essentially constant power output on the driven shaft, regardless of its speed due to this consistent efficiency of energy conversion, its torque output will thereby increase substantially as its speed decreases. This torque increase between driving and driven shaft is obtained by the help of the stationary reaction member, which carries the differential torque. The differential torque will, as in every other transmission, try to turn the housing in the opposite direction to the shaft. The rigid connection to the frame, however, prevents this.

As indicated before, the power necessary to drive the pump stays constant if its speed is constant, also. There is, however, quite a variation of that power as the speed of driving shaft and pump changes. The law governing this, the fundamental law of all hydraulic machinery, is that the power input varies with the third power of the speed. Thus, if the 10 hp. is required to drive the pump at 500 rpm., 80 hp. will be necessary to speed it up to 1,000 rpm. In this way, the same torque converter can be adopted to a wide range of power requirements by simply changing its primary operating speed.

The two-speed gearbox consists of two gear sets which are always in mesh. Clutching between the two is obtained through the use of hydraulic clutches consisting of plates with annular V-grooves which match a set of pistons with similar grooves. The pistons are carried in a drum which is attached to the shaft. The clutch plates form the hub of the gear. When it is desired to engage this clutch, pressure is applied to the pistons by oil supplied from a small high-pressure pump coupled directly to the torque converter pump. When it is desired to change from "high" to "low," or vice versa, the handle of the shifting valve is moved by the operator, going from "low" to "neutral" to "high." This relieves the pressure behind one set of pistons and applies a pressure to the other set of pistons. Since the supply of oil to the clutches comes through the shift valve, there is no possibility of engaging both clutches at one time. Also, due to the fact that there are no jaws to engage or gears to mesh, it is impossible to shift improperly.



This view gives a graphic idea of the severe conditions to be met by the "Bear's" new Atlas Diesel propulsion engine.

"U. S. S. BEAR"

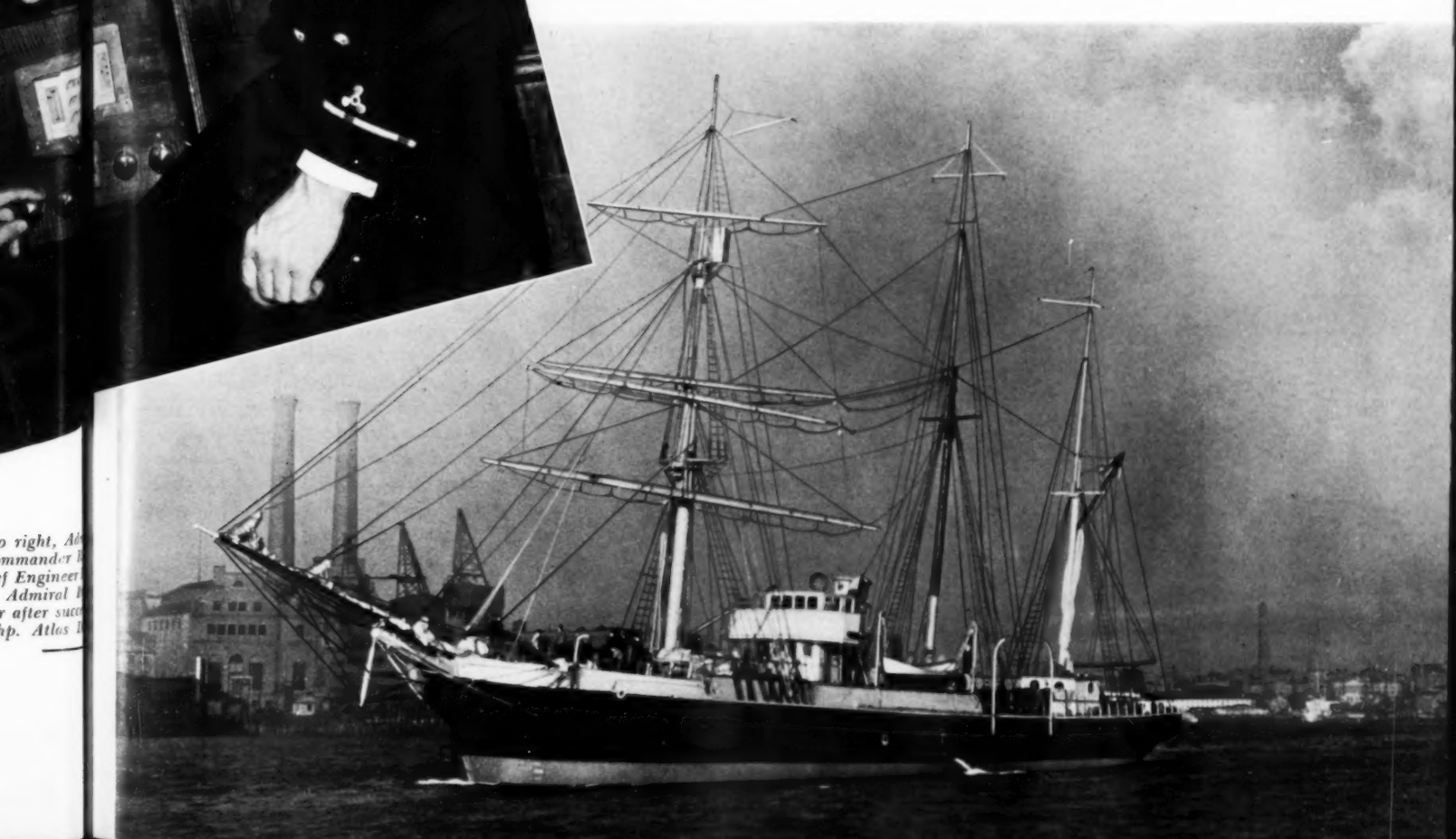
South Polar Expedition Flagship Converted to Diesel Drive

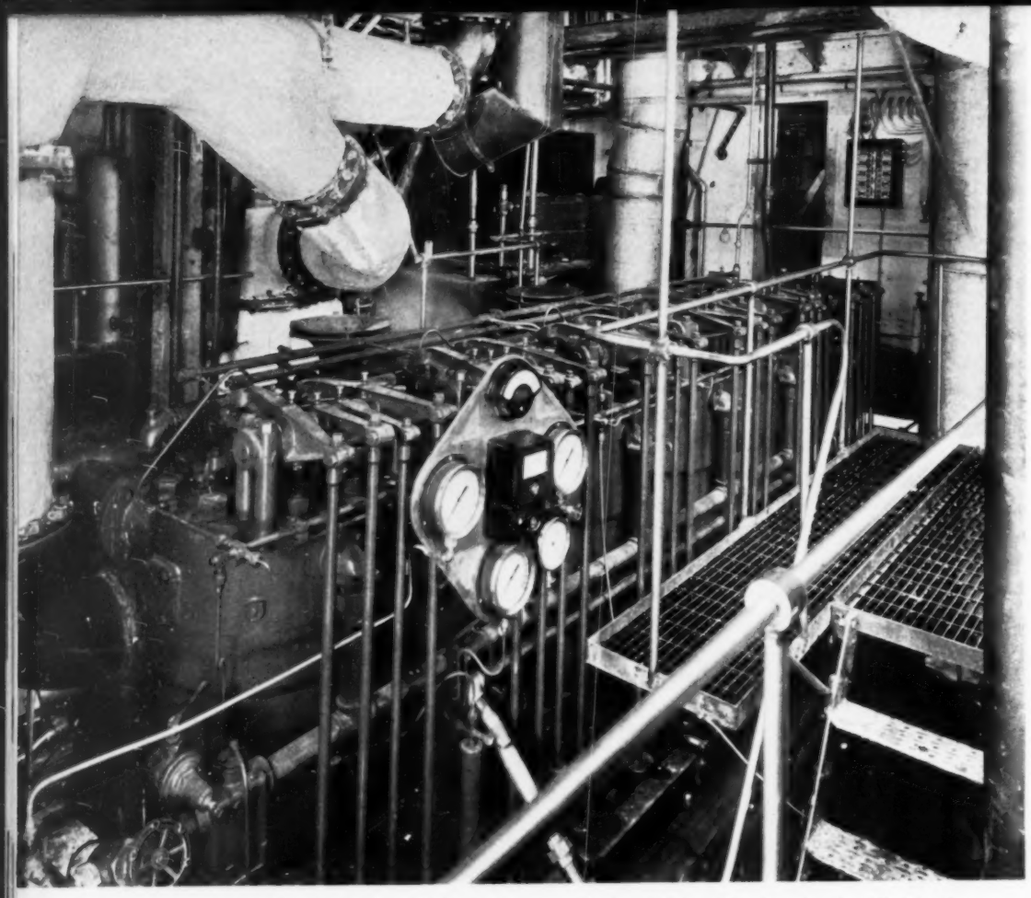
We have with us, left to right, Ad Richard E. Byrd, Lt. Commander Cruzon, Master and Chief Engineer Dawley. "U.S.S. Bear," Admiral B flagship in Boston harbor after succ trials of her new 600 hp. Atlas D engine.

THE unparalleled success of Admiral Byrd's two previous Antarctic expeditions in no way minimizes the danger and hardships of his present trip now in progress, except insofar as he has been able to profit from personal experience with South Polar conditions to improve organization and equipment. Stringent demands of time and distance conspire to elevate supply transportation to a problem of the first magnitude. Although far less interesting and romantic than the many heroic exploits attendant to exploration, ship performance remains the key to success or failure of such an ambitious venture. It is not surprising, therefore, that a decision was reached last summer to modernize the machinery of the *Bear*. Her ancient steam engine, although dependable, could not match modern Diesel efficiency and the coal for her boiler represented acute problems of storage and handling. Certainly, space and weight savings were never at more of a premium than on this ship, and nowhere else could such important savings be made than by converting both main and auxiliary power from coal-fired steam to Diesel. This change not only doubles the previous cruising range but reduces fuel tonnage by fifty per cent and permits the loading of 200 tons of additional supplies so vital to the expedition upon arrival at its base. Reduction in engine room crew makes possible a corresponding increase in members of the shore personnel and expansion of the scientific staff.

Probably no one will appreciate the new Diesels more than veterans of the last trip, who recall too vividly the coal piled on deck after all available spaces were filled and, despite these extraordinary measures, the necessity of refueling at sub-zero temperatures by carrying coal in bags from the *Jacob Ruppert* and hoisting it by hand from long boats to the deck of the *Bear*. However, that is all history and the sturdy ship that was launched a quarter of a century before Dr. Diesel built his first engine is now fitted with the most modern of this type marine propulsion.

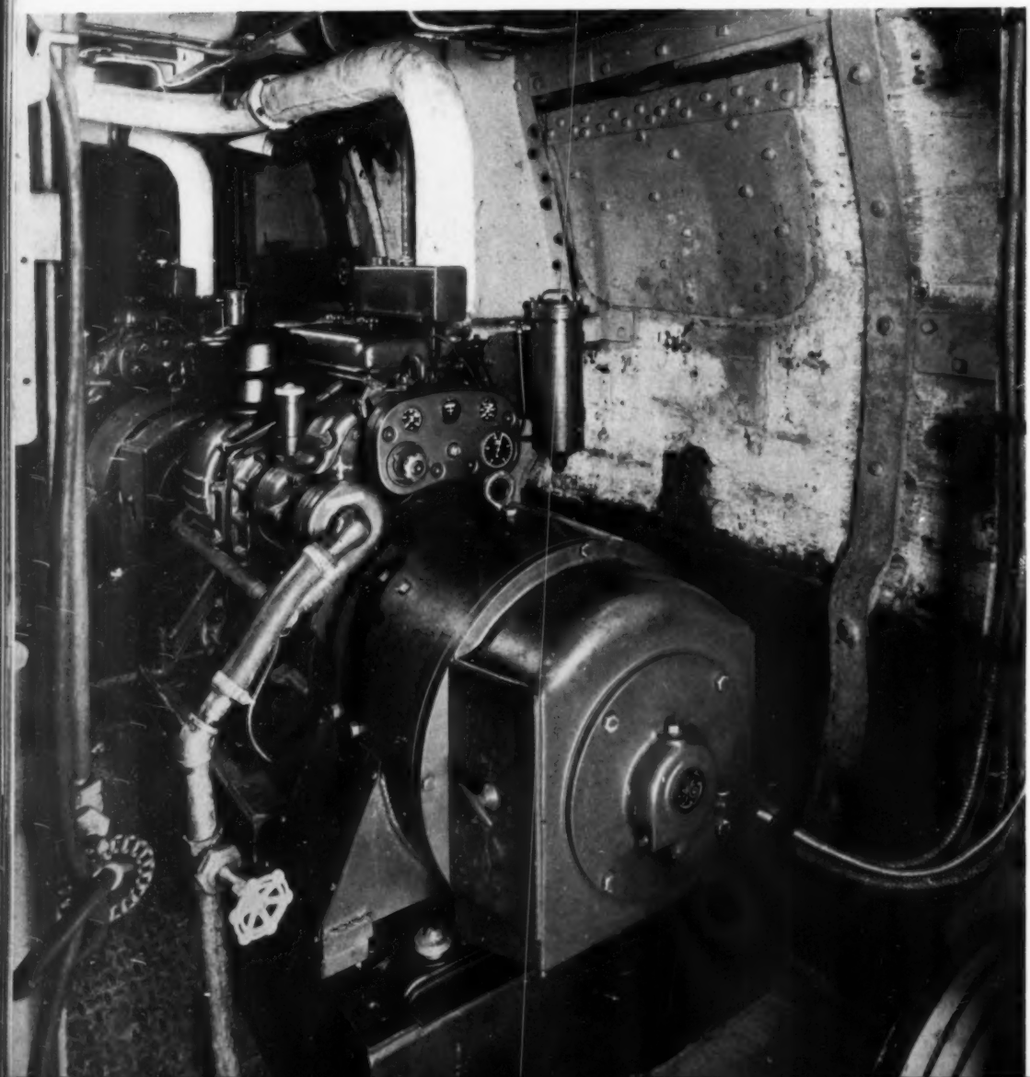
The contract for conversion was awarded to the Atlantic Works of East Boston, with all work under the personal supervision of Mr. George Galley, Naval Architect, and in record time her boilers, coal bunkers, two cylinder compound steam engines and all steam auxiliaries were removed to make way for complete new engine room equipment. The unit selected by Admiral Byrd for main propulsion is a slow speed, heavy duty, 6 cylinder Atlas Imperial Diesel engine rated at 600 hp. at 300 rpm. Mounted on the same integral steel sub-base are a Dynamatic magnetic clutch, a Falk 3:1 reduction gear and a Kingsbury thrust bearing in the order named. A four blade Ferguson





View showing the new Atlas Imperial 6-cylinder, 600 hp. Diesel engine installed in the "U.S.S. Bear." Note Weston tachometer and Alnor pyrometer on the gauge board.

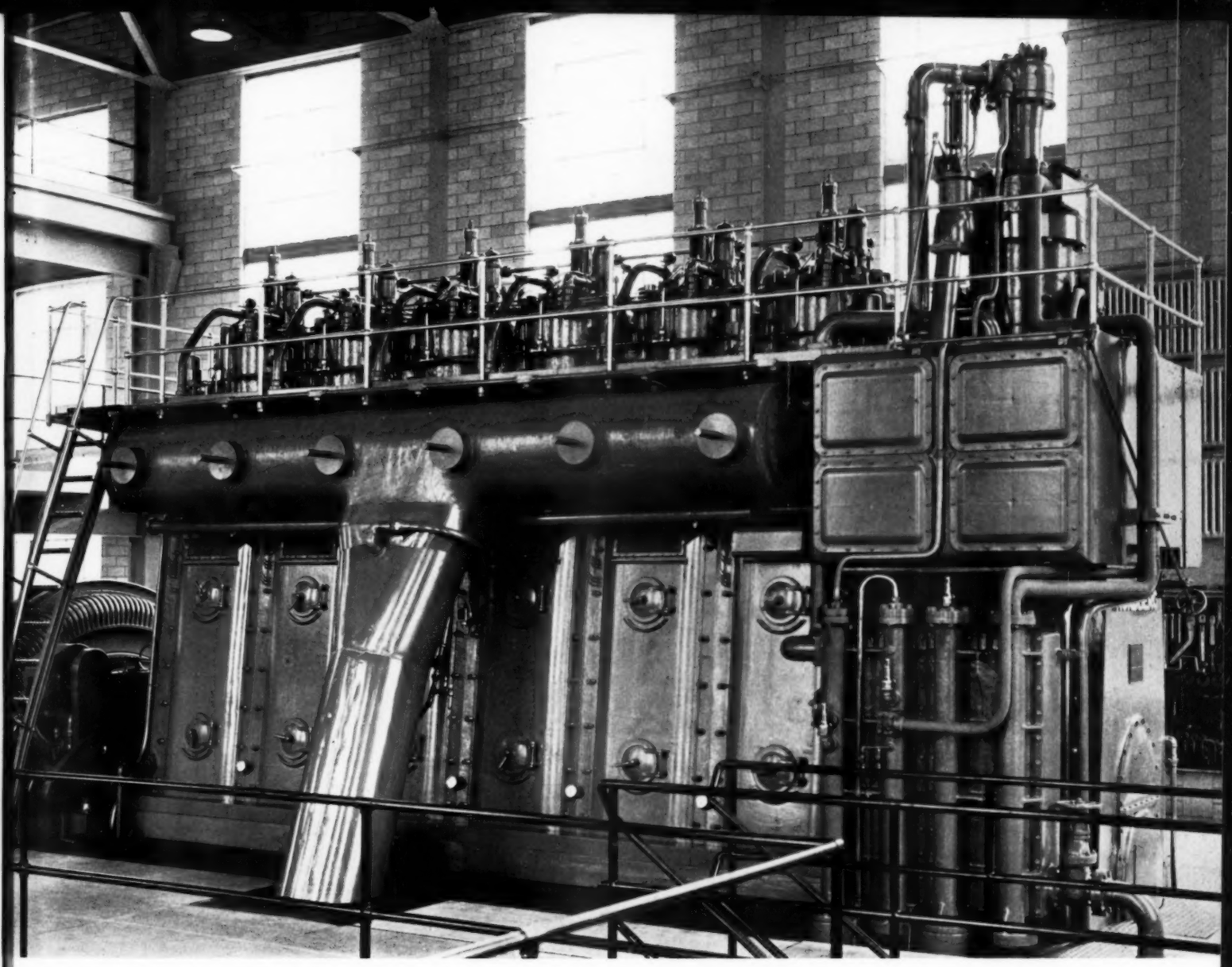
Auxiliary power for the "U.S.S. Bear" is supplied by two General Motors, small series 71 Diesel engines, driving General Electric 30 kw., 125 volt generators.



semi-steel propeller gives the desired 9½ knots. Engine-mounted equipment includes Purolator lube and fuel oil filters, Alnor exhaust temperature pyrometer, Weston electric tachometer and the usual pumps and gauges. Fresh water cooling is employed by means of a Condenser Service & Engineering heat exchanger suspended from the fidley on the port side. Exhaust gas passes through a submarine-type evaporator that is capable of producing 200 gallons of fresh water per day from sea water while the main engine is in operation. Provision is made for connecting the exhaust manifold directly to the tail pipe if it is desired to cut out the evaporator for any reason. A Goulds Hydroil, which will operate on either the continuous or batch system, is provided for reclamation of lubricating oil. The latter method will generally be used to accommodate both main and auxiliary Diesels. Starting and maneuvering aid is supplied by a Curtis motor-driven compressor which augments the regular engine-driven compressor unit.

Electric current for lighting and all auxiliary equipment is furnished by two General Motors Diesels directly connected to 30 kw. 125 v. General Electric generators. Exide batteries are maintained fully charged at all times for an emergency and, if necessary, a small Kohler generating set with a Waukesha-Hesselmann engine can be cut into the lighting line. All three of these generating sets are equipped with Maxim spark arrester-silencers. All bilge, fire, fresh water and sanitary lines are served by motor-driven pumps. The Sperry gyro-compass and steering gear are also electrically operated. In respect to auxilaries as well as main propulsion considerable saving is effected in fuel by the displacement of steam by Diesel power. Furthermore, fuel is burned only when needed due to the instant availability of the Diesels from a cold start. The heating boiler and galley stove are oil-fired, which eliminates all necessity of carrying coal.

Similarly, the other vessel in the expedition, the U. S. Department of the Interior cutter *North Star*, is also Diesel powered with a 1,500 hp. McIntosh & Seymour main propulsion Diesel and two 110 hp. Atlas Imperial Diesel generating sets. Both are ice breakers and have seen much polar service, although there is no ship now in commission that can match the 65 year record of the *Bear*. Her thick oak planks on closely spaced frames have withstood more ice than could reasonably be expected of any ship and she is still going strong. Her hull is in as good condition as ever and her new Atlas Diesel now makes her of maximum value for the most exacting marine service in the world.



The new 2,250 hp. Nordberg Diesel Engine generator unit. Space to accommodate the second unit is enclosed by the hand-rail at lower left of view.

HILLSDALE, MICHIGAN

By R. D. CAMPBELL

DURING the month of September, the city of Hillsdale, Michigan, began generating a part of its power requirements with a Nordberg Diesel engine. The city has owned its own municipal water and power systems for many years but, prior to this time, all power was generated with steam. The city water system was placed in operation in 1886 and, in 1893, the city began to generate power for a municipal plant equipped with steam engines. As the years passed, the engines were gradually displaced with turbines of 300 kw., 625 kw., 750 kw., and 1,500 kw. capacity. All of these units generated two phase, sixty cycle current, but the city system is presently being changed over to three phase.

Orders for the new unit were placed late in 1937, but its installation was delayed pending the completion of a new building arranged to accommodate two identical engines. The new unit consists of a six cylinder, 21″ x 29″, two stroke cycle, 225 rpm., air injection, 2,250 hp. Nordberg Diesel engine directly connected to a 1,500 kw., 3 phase, 60 cycle, 2,400 volt Allis-Chalmers Alternator. An Allis-Chalmers 25 kw., 1,150 rpm. exciter is V-belt driven from the alternator shaft. This engine is similar to a number of Nordberg engines built in recent years, in that it has no flywheel. The inertia requirements are provided for by increasing the weight of the alternator rotor. On first thought, it might appear that such an arrangement would require a rotor of unusually large size and great weight. This assumption would be correct for a four-stroke cycle engine with

fewer cylinders; however, the flow of power from a six cylinder two-stroke cycle engine is relatively uniform, thus reducing the required flywheel effect. The engine runs with very little cyclic variation in speed as is evidenced by its fine operation when synchronized with the steam turbines.

The engine is equipped with a Woodward isochronous governor with switchboard control. The engine is synchronized by the operator at the switchboard located in the turbine room of the old plant. The new building is designed for two Diesel engines and is separate and apart from all of the steam generating equipment. The switchboard in the new building is of the steel panel type and is equipped with the following instruments:

Voltage Regulator, Allis-Chalmers Rocking Contact Type (Brown-Boveri Design)
A.C. Ammeter, GE Type AD-7, 0-600 amps.
D.C. Ammeter, GE Type DD-7, 0-300 amps.
A.C. Voltmeter, GE Type AD-7, 0-3,000 volts
D.C. Voltmeter, GE Type DD-7, 0-150 volts

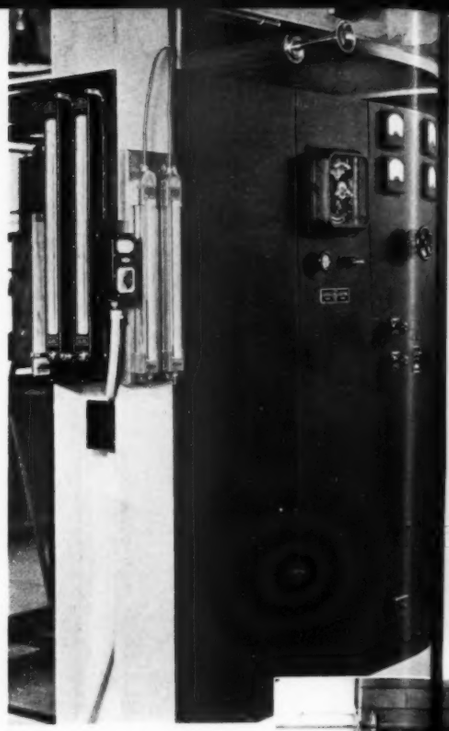
The main switch, kilowatt meters, and all synchronizing controls are located on the main switchboard in the old plant.

The new building for housing the Diesel engine is of concrete and brick construction and includes a full size basement, the engine room floor, and two galleries extending across the southeast end of the building. The basement has concrete walls and floor, while the main engine room is finished in glazed tile of two colors: a mottled green tile extending to a height of twelve feet, and an old ivory colored tile continuing from this point to the roof trusses. The windows are of a metal sash type and extend well above the height of the engine so as to give as much natural light in the building as possible. A double I-beam traveling crane extends lengthwise across the engine room, having a span of 50 feet and a capacity of 5 tons. It was manufactured by the Shaw Box-Crane and Hoist Division of Manning, Maxwell & Moore, Inc.

Air for the engine is drawn in through a battery of 20 type OC American Air Filter cells located in a concrete filter house at the rear of the building. The exhaust silencer is located on the same end of the building and both the air inlet and exhaust pipes pass through the basement just beneath the engine floor level. The exhaust from each cylinder is equipped with a thermocouple connected to a Brown Model 1006 pyrometer instrument having a range of 0 to 1,000° F.

The engine burns a Michigan fuel oil of 26-28 gravity with a relatively high pour point and flash point. By the proposed ASTM classification the fuel would be between a No. 4 and No. 5 in general characteristics. The fuel oil storage consists of two 100,000 gallon vertical tanks located on a small knoll about 400 feet from the building. The oil in storage is heated by the engine jacket water forced through the oil heating circuit by means of a 1½" x 1¼" 1,750 rpm. Chicago Pump Company centrifugal pump directly connected to a ¼ hp. Baldor electric motor. The fuel oil flows by gravity from the storage tanks to the fuel oil pump in the basement from which point it is delivered to the overhead day tanks located upon the second gallery or balcony which is 20 feet above the engine room floor. The fuel oil pump used to raise the fuel from the basement to the day tanks is a 1" Blackmer Maid size 20 gear type pump directly connected to a 1 hp. 860 rpm. Type AR 3/60/220 Allis-Chalmers electric motor.

The day tanks consist of two vertical cylindrical shaped 400 gallon tanks having conical bottoms. The tanks are connected so as to

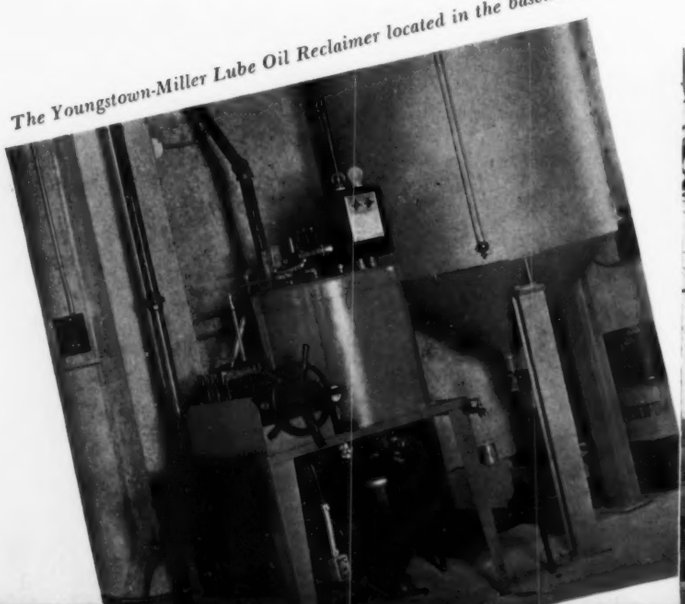


The General Electric Switchboard with Allis-Chalmers (Brown-Boveri Type) Voltage Regulator. Note Edwards Alarm and horn-top, King Telegages at left for main storage tanks and gauges on front of the column for fuel and lube tanks.

View of the engine taken from balcony, showing operating side of the engine. Note the Woodward Governor, American Bosch fuel Injection Pumps and opening in the floor for second unit, right.

The new concrete and brick building designed to house two Diesel engines.

The Youngstown-Miller Lube Oil Reclaimer located in the basement



form a common supply, and the fuel oil level in these tanks is indicated by a King Model B-4 Telegage located adjacent to the switchboard on the engine room floor. The fuel flows from the day tanks through a Bowser XACTO meter and into the engine reservoir tank. The engine reservoir tank is 32″ x 72″ x 48″, holding about 500 gallons, and is divided into two compartments, one for starting fuel and one for heavy fuel. A starting fuel need only be used when the regular fuel is a very heavy residual oil with poor ignition characteristics. The heavy fuel compartment is equipped with heating coils by means of which the fuel oil may be heated up to the jacket water temperature, thus reducing its viscosity and aiding ignition. A float valve in the reservoir maintains the fuel at a predetermined level at all times. The engine draws the fuel directly from this reservoir, and any fuel leakage from the pumps is returned to this tank. The Bowser meter recording the fuel flow from the overhead day tanks to the engine reservoir is in continual service, as the fuel is continually flowing to the reservoir, maintaining a constant fuel level. The heating of the fuel oil out in the storage tanks and in the engine reservoir allows the handling and injection of a much heavier fuel than could be used otherwise. No starting fuel is being used at present as the engine starts quite readily on the regular fuel.

An indirect or dual circuit cooling system is used to cool the engine. The raw water is taken from a small lake located near the plant. This same lake has provided condenser cooling water for the steam equipment for many years. The raw water is circulated through a Schutte-Koerting size 10-2P heat exchanger by a 4″ x 4″ type SH Allis-Chalmers centrifugal pump directly connected to a 10 hp. 1,750 rpm. Allis-Chalmers electric motor. This pump unit is rated to deliver 565 gpm. at 50 ft. head pressure. The raw water from the lake is passed through the oil cooler before entering the cooling water heat exchanger. The soft water is circulated by a 4″ x 4″ Type SH Allis-Chalmers double suction centrifugal pump driven by a 15 hp. 1,750 rpm. Allis-Chalmers motor. This

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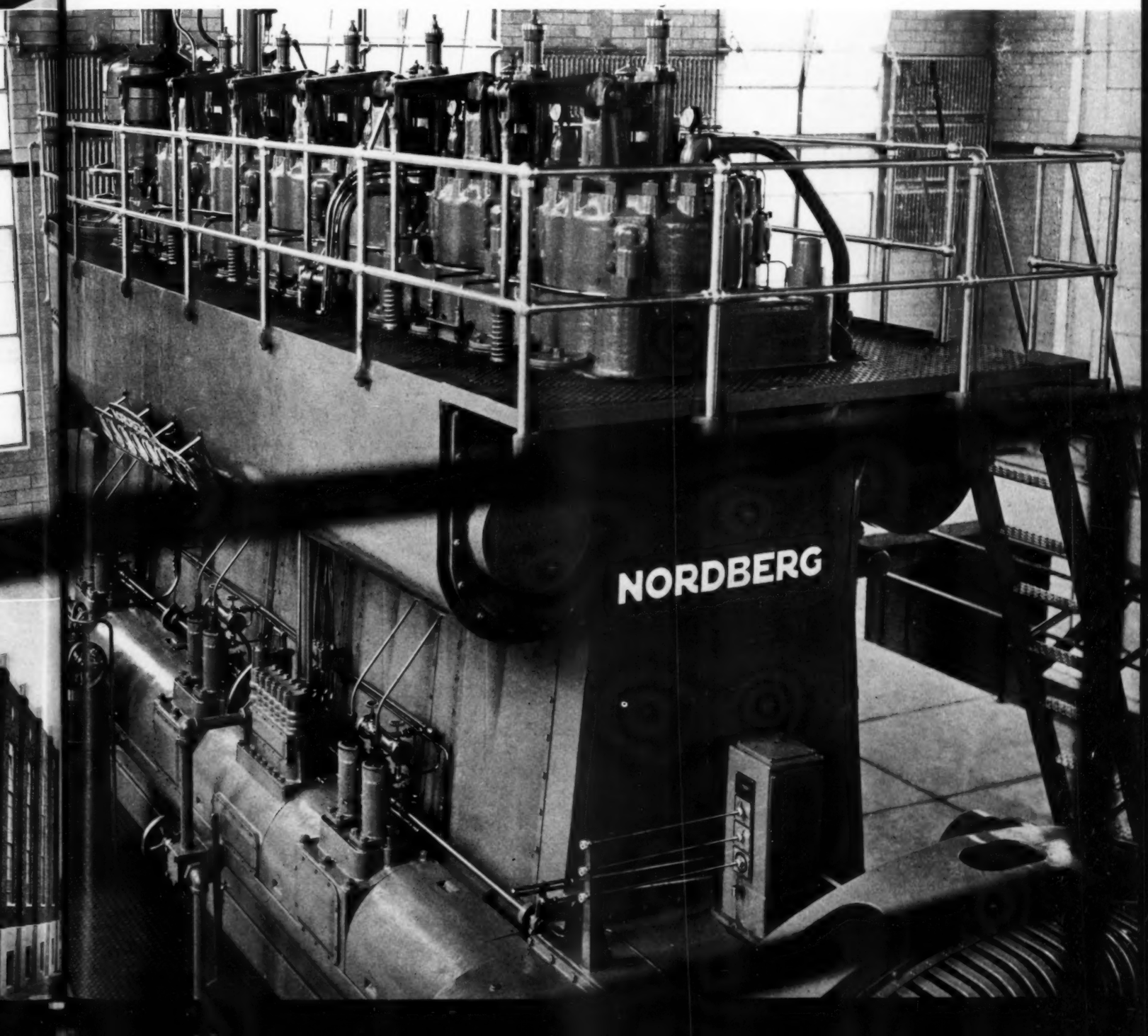


S. POLHEMUS
PORTLAND

"J. S. POLHEMUS"

By CHAS. F. A. MANN

COMPLETED at the plant of the Seattle Shipbuilding Co., on Lake Washington Canal, November 4, the husky, rot-proof, heavily-built Workboat *J. H. Polhemus* left immediately for her new station on the Columbia River, in service as a workboat for the U. S. Engineers' office in Portland.

Looking like a low-slung cannery tender, with a tugboat type deckhouse atop, the *J. S. Polhemus* carries a new-type, medium weight 350 hp. 6 cylinder 12 in. bore by 15 in. stroke Enterprise Diesel for her main power. The engine is direct reversing, and is of the trunk piston type, with principal auxiliaries built in, except the pumping and auxiliary generator layout. An interesting feature of her power plant, found on few ships of any size, is the dual pilot house and engine room control. Both pilot house and engine room control stations are fitted with complete instruments and gauges for operation either above or below decks. A new type of Sperry electro-mechanical steering gear has been installed to simplify the ticklish work of contacting jetties, dredges, etc., even when the Columbia River is in full flood stage.

Top — Two views of the U. S. Engineers' new Diesel-propelled workboat "J. S. Polhemus." Left Center — View in the wheel house showing dual instruments and controls which permit full maneuverability of the engine above decks. Left — Control station of the Enterprise Diesel propulsion engine. Note Weston tachometers in both wheel house and engine room.

The vessel is designed as a husky workboat, for dredge tender service and work on the jetty system in the Columbia River, and is primarily a day boat. Low slung, to give easy access to the main deck, the ship is of heaviest, rot-proof and foolproof wooden construction that is possible to turn out. Her principal dimensions are 84 ft. x 22 ft. 10 in. x 8.9 ft. moulded depth and 7 ft. 6 in. draft aft and 7 ft. draft forward. She carries 7½ tons of fuel and 8 tons of fresh water in 3 fuel tanks and 4 fresh water tanks respectively. She carries six starting air bottles, 24 in. in diameter and 8 ft. long, to assure at least 200 complete starts or reverse movements in close maneuvering work in swift water. The hull is stiffly built of heavy Alaska and Port Oxford Cedar and Douglas Fir, double framed and double planked throughout, and sheathed with ironbark at vital points. The deckhouse and pilot house are of cedar and fir. The crew's quarters for six are provided on the main deck, with large storage lockers and a roomy galley equipped with a Westinghouse refrigerator and a Lang oil fired cooking range and hot water heating system. Toilets and showers are provided on the main deck, as well as a small hold for gear fore and aft of the engine space. A large pilot house with Captain's and Engineer's quarters has been provided. Her sturdy Markey Deck Machinery, including a three-drum windlass forward and a towing engine on the rear deck, is designed to handle heavy dredge anchor gear when in service as a dredge tender. The Markey deck machinery, built by the Markeys in Seattle, is air driven. Air is supplied at 125 lbs. for deck machinery, 250 lbs. for starting the main engine, and 100 lbs. for the whistle.

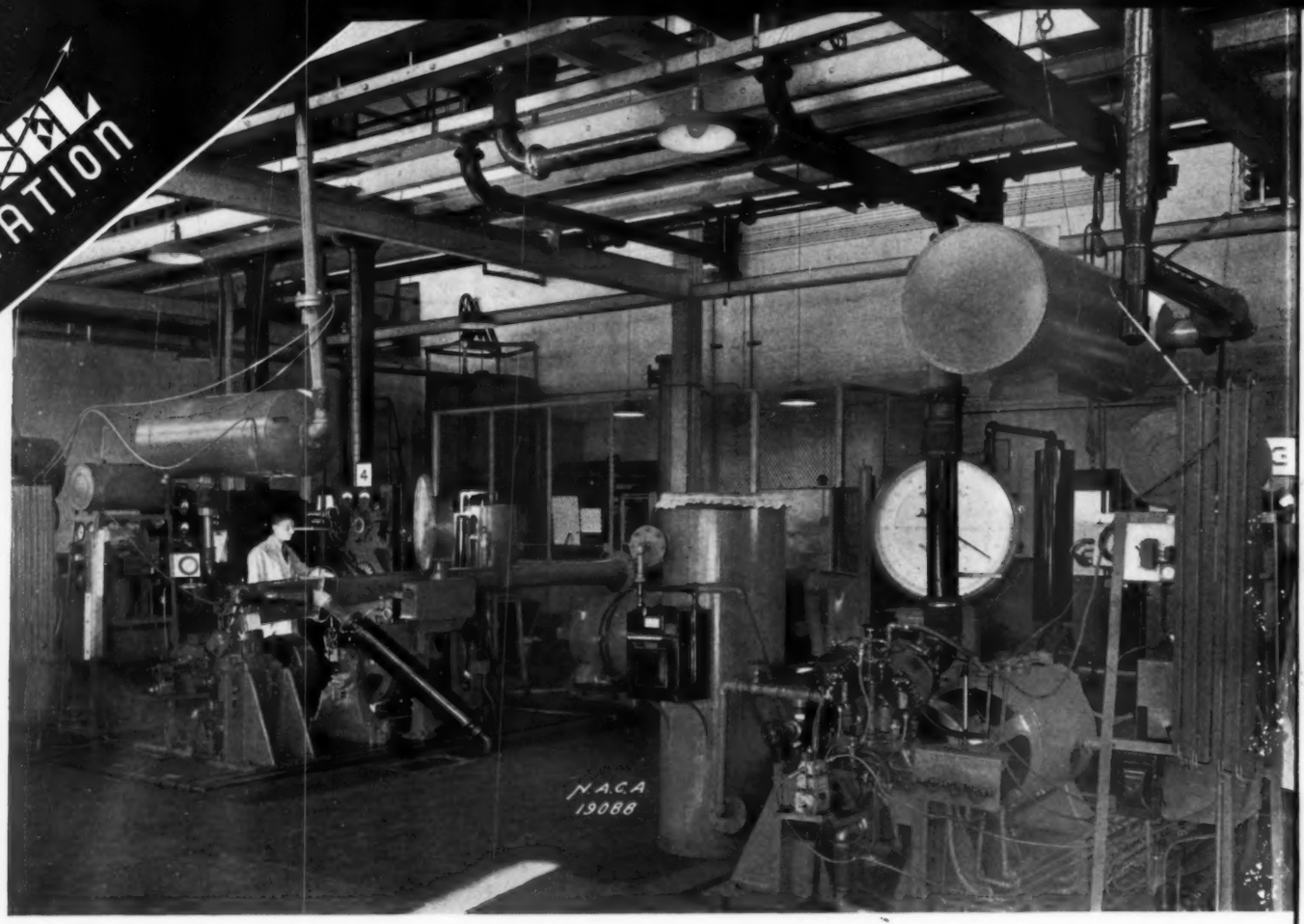
The ship has a 66" x 36" Coolidge, four-bladed propeller. A Brown exhaust pyrometer is fitted on the gauge panel at the engine control stand. A 5 kw. Westinghouse belt-driven generator off the main flywheel normally charges the 100 cell, 150 amp. hr. 110 volt Edison storage battery set. A 30 cfm. Ingersoll Rand air compressor, driven by a 15 hp. motor is carried, as well as a Vortex muffler. A Kingsbury thrust bearing, Jones oil bath tailshaft bearing, Nash 10 hp. fire & bilge pump, Nash fresh water pump are some of the major items of auxiliary equipment installed. A De Laval oil purifier, 2 Craig pumps, Cuno oil filters and a 7-bottle CO2 system for fire fighting is carried, also.

The auxiliary generating set consists of a 3-cylinder Enterprise Diesel, 80 hp., driving a 50 kw. Westinghouse generator, regulated by a carbon pile voltage regulator and handled by a Westinghouse dead front switching panel. The auxiliary generator provides current at 110 volts for all auxiliaries.

Mr. O. A. Seigley, veteran naval architect with the Portland U. S. Engineers Office, designed the ship and superintended its construction at the yard of the Seattle Shipbuilding Company. W. C. Nickum & Sons of Seattle, prominent naval architects, supervised the preparation of plans, with George Nickum in direct charge.

This Diesel dredge tender *Polhemus* was built only after very careful consideration of its suitability for the service, as it was thought originally that only a steam tug or possibly a Diesel tug with clutch reverse gear could handle the type of work which this dredge tender must do. Her performance in service, however, has demonstrated the ability of a direct reversible engine to maneuver quickly enough and to run slow enough to accomplish all that was desired.

DIESEL AVIATION



Water-cooled (No. 3) and air-cooled (No. 4) Diesel test engines undergoing 25-hour tests in the N.A.C.A. laboratory at Langley Field.

DIESEL AIRCRAFT ENGINE RESEARCH BY THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS — PART I

By PAUL H. WILKINSON

LANGLEY FIELD, Va., December 14. Through the courtesy of the National Advisory Committee for Aeronautics, the writer was permitted to see and discuss the various phases of Diesel research which are being carried on at the Langley Memorial Aeronautical Laboratory at Langley Field. Here it was found that more than six hundred people were employed in aeronautical research and that some of them were being trained for the new $10,000,000 N.A.C.A. establishment now being constructed at Sunnyvale, near San Francisco. At a rough estimate, it appeared that from 25 to 30 people were engaged on Diesel engine research including the necessary machine shop and tool room work incidental to such projects. The work was divided into two groups — engine research and fuel research.

The engine laboratory consists of a large two-story building in which most of the ground floor is devoted to engine test beds and similar layouts. No full-size engines are tested by the N.A.C.A. as their work is confined to test engines of one or two cylinders. The cylinders, pistons and operating gear of the test engines are identical with those intended for full-size engines and so it is possible to estimate very closely the ultimate performance of complete power plants. In the case of the Diesel, this works out very well as the performance of this type of engine on the test bed can usually be duplicated with a full-size engine inasmuch as the Diesel is not particularly sensitive with regard to its fuel.

On the upper floor of the main building, are store rooms and an assembly room in which motion pictures of phenomena such as fuel injection and combustion can be shown. These films are of great interest as they show many interesting events inside the engine which otherwise could only be guessed at in the ordinary run of events. In a nearby building, excellent facilities are provided for machine work and precision work relative to pumps and nozzles.

The Diesel research projects under way at the laboratory cover a wide scope of experimental work. For instance, the projects for improving engine performance include investigations into the possiblities of both air-cooled and water-cooled Diesels of 2-stroke and 4-stroke design. Data was being obtained and analyzed relative

to the functioning of sleeve valves, poppet valves, compression ratios, boost pressures, manifold design, uniflow and loop scavenging, valve timing, port areas and other important matters relative to the high-speed Diesel aircraft engine.

The project for improving the cooling of air-cooled Diesels included experiments with the new N.A.C.A. pre-formed fins and methods for bonding them to the cylinder head and the cylinder barrel. Other projects of interest covered compounded lubricating oils, phenomena of combustion, turbo-supercharging, fuel consumption, fuel rating, altitude performance under simulated conditions and engine calibration. It was encouraging to find such an extensive program under way and the results when they are published, should be of great value to the new industry.

At the time of the writer's visit, both water-cooled and air-cooled 4-stroke Diesel test engines were undergoing 25-hour endurance runs, and a water-cooled 2-stroke Diesel was being prepared for further experiments. An interesting feature of the testing was the method used for supplying the air for scavenging and boost. Air under pressures up to 10 lb. per sq. in. was supplied by portable supercharger sets comprising a Ford V-8 engine direct-coupled to a Nash blower and provided with a suitable surge tank.

The water-cooled, 4-stroke Diesel on test had a bore and stroke of 5.00 in. and 7.00 in. respectively and a displacement of 137 cu. in. It had poppet valves for inlet and exhaust and was being boosted by means of a separately driven blower with air at a pressure of 10 lb. per sq. in. At its maximum speed of 2,500 rpm., the engine developed 86 hp. with a bmep. of 200 lb. per sq. in. This is equivalent to 0.63 hp. per cu. in. of displacement and is a good indication of what may be expected from an engine of this type.

The other 4-stroke Diesel on test, had an air-cooled cylinder of the same internal dimensions as the cylinder of a Wright Whirlwind R 975 E3 gasoline aircraft engine. That is to say, it had a bore and stroke of 5.00 in. and 5.50 in. respectively and a displacement of 108 cu. in. It was noticeable, however, that the Diesel cylinder was appreciably shorter in height due to the use of horizontal poppet inlet and exhaust valves. The cylinder head was deeply finned and was made of aluminum alloy. It contained a combustion chamber of the displacer type (as shown in the illustration) and was screwed and shrunk onto a steel barrel provided with short cooling fins. The barrel was attached to the crankcase in the usual way with eight studs and nuts. The piston was provided with an integral rectangular air deflector and was machined from an aluminum alloy forging.

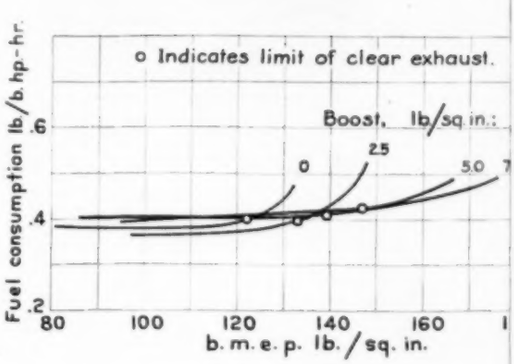
Based on the performance of this single-cylinder test engine, the performance of a 9-cylinder engine equipped with these cylinders had been estimated. It was found that a full-size air-cooled Diesel should have an output of 500 hp. at 2,250 rpm. for take-off with a boost pressure of 7.5 lb. per sq. in. and a bmep. of 180 lb. per sq. in. This is equivalent to a specific output of 0.51 hp. per cu. in. and compares favorably with the specific output of the water-cooled Diesel. Incidentally, the Wright Whirlwind R 975 E3 gasoline aircraft engine is rated at 450 hp. at 2,250 rpm. for take-off, with a specific output of 0.47 hp. per cu. in. and a bmep. of 165 lb. per sq. in.

For cruising, it was estimated that if the air were supplied at a pressure of 2.5 lb. per sq. in., the Diesel would have a bmep. ranging from 100 to 120 lb. per sq. in. and a specific fuel consumption of 0.36 lb. per hp. This too, is a better performance than that of the gasoline engine and points the way to the early adoption of a Diesel of medium power output. It is possible that there might be a slight increase in specific weight but this would be more than offset by the substantial increase in specific output and the reduction in specific fuel consumption.

The fuel injection system used on these two test engines consisted of a standard Bosch high-pressure pump with variable timing together with a hydraulically-operated injector at the top of the combustion chamber in the cylinder head. The injector was fitted with a six-hole nozzle with the axes of the fuel sprays separated by angles of 25 degrees. The shape of the combustion chamber necessitated that the fuel sprays should be in the same plane, i.e., in the shape of a fan. The two inner holes had a diameter of 0.025 in., the two intermediate holes had a diameter of 0.023 in. and the two outer holes had a diameter of 0.013 in. The fuel was injected at a pressure of 3,500 lb. per sq. in.

These experiments with water-cooled and air-cooled 4-stroke Diesels have proved fairly conclusively that there is no unsurmountable difficulty in design and building medium-powered Diesel aircraft engines at the present time. The air-cooled experiments are particularly interesting in view of the urgent demand for Diesels in the 500 hp. to 600 hp. power class for use on the observation and scouting planes carried on our battleships and cruisers.

N.A.C.A. AIR COOLED DIESEL CYLINDER
5 IN. BORE × 5 ½ IN. STROKE



The new air-cooled, 4-stroke, displacer-type cylinder with which excellent results have been obtained.

The N.A.C.A. engine test laboratory at Langley Field, Virginia.

"PROGRESS" AND "PATRIOT"

Two Powerful New Diesel Towboats

BY GEORGE D. CROSSLEY

LATE October saw the second of a pair of capable new towboats going into service for the American Barge Line Company of Louisville, Kentucky . . . added evidence of the constantly increasing use of oil fuel engines in river towboat service. Both of these vessels are Diesel-driven, twin-screw craft, identical in design and intended for heavy towing service on the lower Ohio and Mississippi rivers. Named *Progress* and *Patriot*, the vessels are two of the most powerful Diesel towboats plying the inland waterways.

The hulls for both vessels were built by the Treadwell Construction Company, of Midland, Penna. Upon completion, they were taken to the yards of the Jeffersonville Boat and Machine Company, at Jeffersonville, Indiana, where the vessels were fitted out and their engines installed. The Jeffersonville Company is directly across the Ohio River from the Louisville offices of the American Barge Line Company. R. F. Brandt, superintendent of transportation for the barge line, was in charge of the building and fitting out of the two vessels. ably assisted by G. E. Darling of the boat builders.

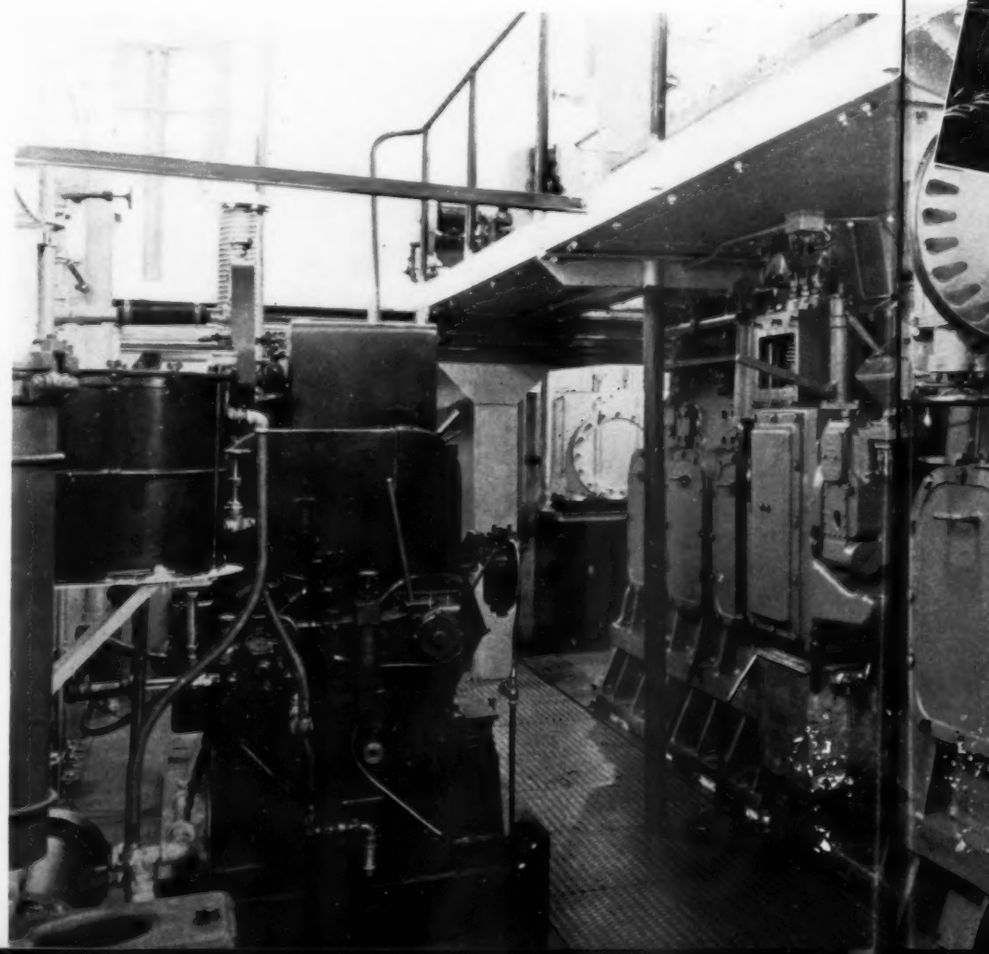
The *Progress* and *Patriot* are riveted steel hulls 160 ft. long, 40 ft. wide, and 8 ft. deep. The superstructures of both vessels are of welded construction and give the correct impression that these are strictly work boats, ginger-bread being noticeably absent. Both vessels are tunnel-stern type and each is powered with two Cooper-Bessemer, Type LT, direct-reversing, eight-cylinder Diesel engines. These engines are rated 800 hp. at 275 rpm. and are fully capable of 1,000 hp. at the conservative speed of 300 rpm., giving each boat a total of 2,000 available hp. These are the maker's next largest Diesel units, having a cylinder bore of 15½ in. and piston stroke of 22 in. Pistons are oil-cooled. Piston rings for the four engines are American Hammered make.

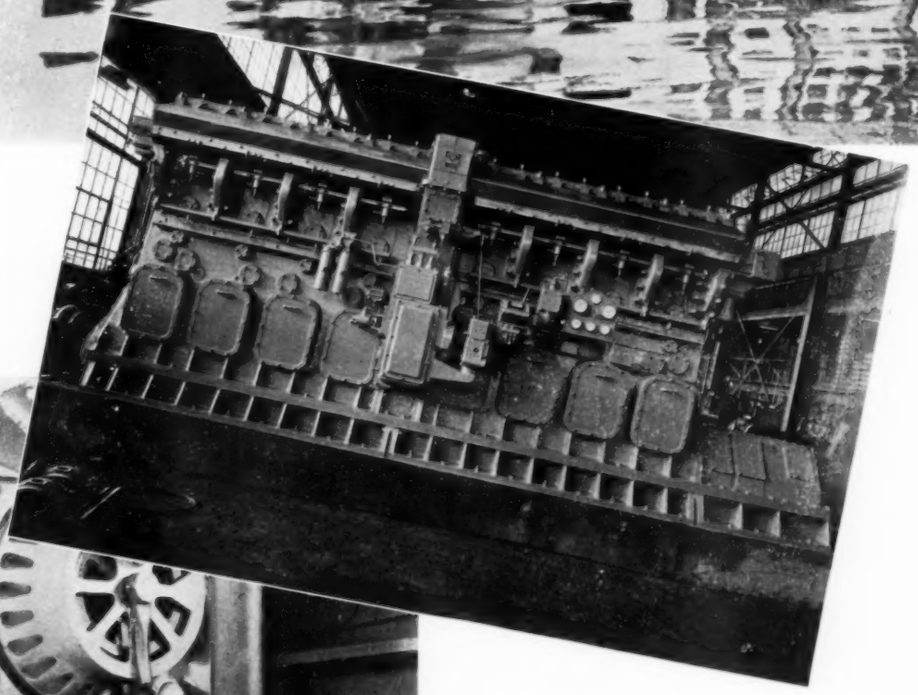
Mr. Frank Akhurst, of the American Barge Line Company, visited the Cooper-Bessemer plant during the building and final tests of the engines. Mr. Akhurst inspected all materials which went into the engines, watched closely their assembly, and thoroughly familiarized himself with the units. Due largely to this intelligent procedure on the part of boat owners, there has never been a call upon the engine manufacturer for the services of an erection engineer.

Each of the four engines is equipped with Andale Duplex lubricating oil strainers and lube oil is cooled through Ross oil coolers. Fuel oil is filtered through Purolator equipment. Pickering 3700 Class Isochronous governors are mounted on the operating sides of the engines immediately adjacent to the control lever and gauge board. These governors are the oil relay type with overspeed safety stops and permit either manual or fully automatic control of engine throttling. For Alnor eight-point pyrometers indicate exhaust temperatures. Each main propulsion engine is equipped with a Weston electric tachometer.

The eight-cylinder Diesels direct drive their propellers through Kingsbury thrust bearings and shafts built into the engines. Among the test requirements which each of the engines had to meet was one which called for them to be reversed from full speed ahead to full speed astern and attain that full speed astern in ten seconds. A design feature of the engines which greatly facilitated the meeting of such requirements is the built-in braking arrangement which utilizes air pressure for braking the engines in either direction of rotation. Starting air in these Diesels is applied to each individual cylinder. This same starting air is automatically applied against the cylinders when reversing the rotation of the engines, thereby functioning as an air brake upon the engine and preventing any rotation from the action of the vessel's wake upon the propeller.

There are two Simms boilers on each ship, both operated from the exhaust heat of the Diesel engines. These waste heat boilers drive steam turbines which generate electricity, and the boilers are auxiliary-fired by oil burners. Thus, when the engines are not furnishing waste heat to the boilers, the oil burners



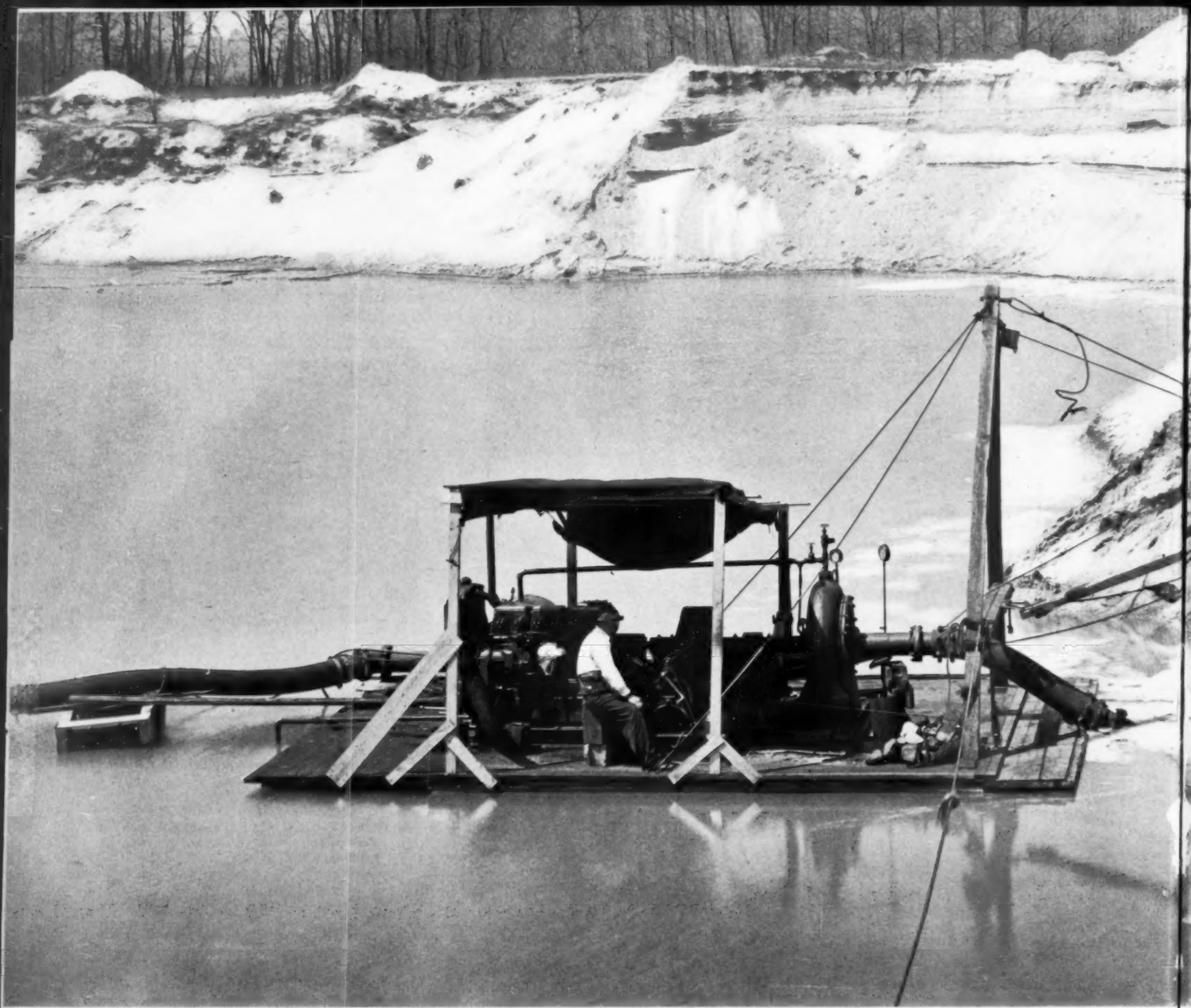


Above — The "Progress," one of two identical Diesel towboats, recently put in inland waterways service. Left — Shop view of the Cooper-Bessemer 8-cylinder Diesels, two of which are installed in each the "Progress" and "Patriot." Lower left — View of lower starboard engine room showing main engine operating station and Superior Diesel-Electric auxiliary generating set.

maintain steam. The light plant, steering gear, capstans, pumps, air compressors, and boat signal are all powered by steam from this source. On each boat there is also a 40-kw. Superior Diesel-electric auxiliary unit, and the steering gear operates upon compressed air when desired.

With no attempt at ostentation, living quarters on these two new towboats are excellent. Rooms for regular crew members are forward of the engine room on the main deck, where there is also a laundry. The kitchen is aft of the engine room and separates the dining rooms for crew and officers. A cabin on the second deck has rooms for master, pilots and engineers, some of these rooms with private baths. Pilot houses and engine rooms are equipped with clocks which strike in "bells" as on seagoing vessels. The exterior appearance of the towboats gives one the impression that they have been modeled after the *Tom Sawyer* type of Diesel boat, and they follow closely the lines of the steam towboat *Helena*.

Among the many factors which enter into profitable or unprofitable towboating is one of major importance. That factor is "standing-time." Here, American Barge Line has eliminated the standing-time expense factor by choosing Diesel propulsion, for the Diesel engines can be shut down and started up at will, with no more trouble and preparation than throwing the lever which admits starting air to the cylinders. Anyone familiar with steam engines can recognize immediately what a saving this means when compared with holding fires and "warming up" steam equipment.



The "Boat," carrying Cummins Diesel and dredge pump, is moved about the gravel pit as required.

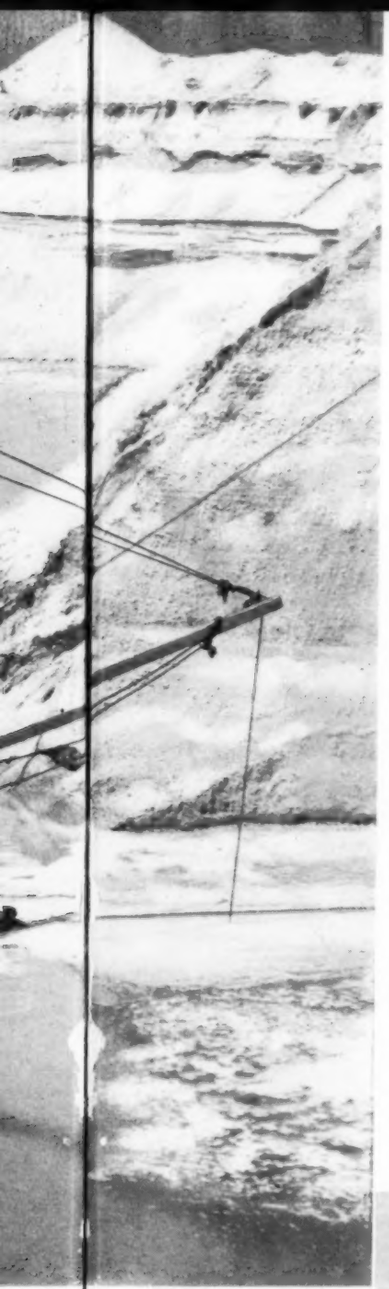
DIESELS SAVE GRAVEL BUSINESS

By DWIGHT ROBISON

FERRYVIEW Sand and Gravel Company is well known to Detroit's contractors and wholesalers. For the last sixteen years, the Ziemann family has been producing gravel from the same pit at Rochester, Michigan, located about twenty-two miles north of Detroit. During this time, different methods of gravel production and different sources of power have been employed. Today, after three years' experience with Diesel engines, Leonard Ziemann says: "During the last three years, since we have been using Diesel engines, the resultant savings not only helped us out of a tight spot but put us a long way on the road to financial stability."

The Ziemanns started in 1923 with a portable rotary dry-screen plant. During the following three years, two similar dry-screen plants were added to the company's equipment and then the largest of the three units, equipped with a bucket conveyor, was rebuilt into a washing plant. Production of sand and gravel averaged about 400 yards per day and with this set-up, the plant was operating until 1935.

More efficient machinery was the next requirement, so the Ziemanns installed an 8 in. Hetherington and Berner dredge pump. Electricity



powered the old plant and the Ziemanns planned to continue using electricity to drive the new pump. But an investigation revealed that electricity, to run the pump, would cost $450 to $500 a month. This, of course, was so far out of line that they turned to a gasoline engine for their power. During the year of 1935, the operation of the pump burned up three different gasoline engines, representing a complete loss of their investment in the engines. Production with the gasoline engines averaged 350 to 400 yards per day at a total operating cost of $330 per month.

In November, 1936, the Ziemanns purchased a Model HP-601, 6-cylinder, 4-cycle Cummins Diesel, delivering 85 hp. at 1,200 rpm., equipped with a Gates V-belt drive, operating the pump at 555 rpm. Because the previous year's production was cut so much by power failures, the new Diesel was immediately put to work. Maintenance cost records of this engine are unusual because it has been run at a constant overload since its installation. The engine is taken down once a year, during the winter when operations are suspended. Rings have been replaced twice, and one new set of rod shell bearings was installed last winter. In three years, the total maintenance expense, including clean-up, routine inspection, etc., has been only $360. Original main bearings are still in use.

The cost of operating the Cummins Diesel varies from $80 to $90 per month. The engine operates from ten to sixteen hours per day and produces fifty to sixty yards of material per hour. Since the installation of the Diesel, there have been no breakdowns or unscheduled shutdowns, and according to Leonard Ziemann, "The Diesel's savings paid for the engine in twelve months."

Originally, the new washing plant was powered with a 10 hp. gasoline engine and its monthly operating costs of $80 were considered too high. In June, 1939, a second Cummins Diesel was purchased and direct-connected to a General Electric 50 kw. generator. One of the ¾ yard cranes, calling for about 35 hp., was equipped with an electric motor. The washing plant was equipped with a 5 hp. motor and a 20 hp. motor was installed on a 16 in. American Road Machinery jaw crusher. Despite the extra equipment used, operating cost of the second Cummins Diesel will not exceed the $80 previously spent for power on the washing plant alone. Mr. Ziemann tells us he expects the second Diesel to pay for itself in seven months.

Proud of his low operating costs, Mr. Ziemann says, "In the three years we have had our first Diesel, not only has it paid for itself, but it has bought us $15,000 worth of other machinery. If we buy more engines, they will be Diesels."

View showing the pontoon pipe line leading to the washing plant. The entire operation may be moved to avoid pumping the material excessive distances.

Another tug—

ANOTHER **MAXIM!**

The Card Towing Company has added one more powerful Diesel-electric tug to their fleet—THE RAYMOND CARD—and quite naturally, one more

MAXIM
SPARK ARRESTOR
SILENCER

has gone to work—safeguarding the vessel and crew from flying sparks and unwelcome noise. MAXIM SILENCERS, the choice of owners everywhere who operate Diesel and gas engine craft, perform with minimum attention . . . effectively silence the exhaust with but negligible back pressure . . . and prevent sparks and carbon deposits from reaching the deck and topsides . . . Efficient . . . Economical . . . Safe!

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Make a Sound Investment

Visit the Maxim exhibit in space 45 at the National Motor Boat Show. See the cutaway model and the demonstration of Maxim spark arrestor silencers.

THE MAXIM SILENCER CO.
HARTFORD, CONN.
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HILLSDALE, MICHIGAN

. . . . *Continued from page 43* . . . .

unit has a slightly larger impeller than the raw water pump and is rated to deliver 565 gpm. at 70 feet total head pressure.

The soft water pump is allowed to operate at full capacity at all times, and the temperature of the soft water (cylinder jacket water) is controlled by throttling the raw water circuit. The piping for both raw and soft water circuits is 5″ pipe and all fittings and joints are welded. Both pumps are equipped with U. S. Gauge Company's pressure gauges. The water and oil circuits are equipped with Motoco Model G Dial type thermometers at numerous points. The cooling water from each cylinder, the cooling oil from each piston, the heat exchanger, and oil cooler all use this same type of thermometer having a range of 60° to 200° F.

Shell Oil Company's TALPA oils are used in the engine, an S.A.E. 30 grade being used in the crankcase. A compounded S.A.E. 30 grade is used on the air compressor cylinders, and an S.A.E. 40 grade is used on the cylinders. The crankcase oil is circulated to all bearings and moving parts by means of a pump. This same supply of oil is used to cool the pistons. A copious supply of oil is circulated and as a result the piston cooling oil operates between 110-125° F., protecting the pistons and rings without damaging the oil. The cross-heads, working pistons, and air compressor piston are all lubricated by Manzel Model 94-D Force Feed Lubricators. There are three of these lubricators having a total of 41 feeds, thus insuring the proper delivery of oil to each vital part. Each working cylinder receives oil at six points well spaced about the circumference.

The heat absorbed by the piston cooling oil is transferred to the raw cooling water in a Schutte-Koerting heat exchanger. The raw water passes through the oil cooler and the soft water heat exchanger in the order named.

Each working cylinder is fitted with rings which scrape the excess oil from the piston. This oil may contain carbon, soot, and partly burned fuel, and is referred to as "dirty oil." The dirty oil thus removed from the pistons is deposited in a separate reservoir and is reclaimed by means of a Youngstown-Miller Oil Reclaimer before being used again as a piston and cylinder lubricant. The same reclaiming unit may be used to clean the crankcase oil, but this need not be done at frequent intervals due to the small possibilities for contaminating the crankcase oil.

The starting air equipment is quite conventional and consists of a Gardner-Denver Model ABD-1015, 5½″ x 1⅞″ x 5″, 2-stage water cooled air compressor driven by an Allis-Chalmers 15 hp., 1,750 rpm., 3 phase 60 cycle, type AR Induction Motor. There are two 28″ x 120″ welded steel air tanks designed for 250 pounds working pressure.

All of the electric-driven auxiliaries in the plant are equipped with Allis-Chalmers Type A-32 across-the-line motor controls with push button controls. All fuel and lubricating oil tanks are connected to King Telegages located adjacent to the switchboard. The Telegages indicate the quantity of liquid remaining in the respective tanks to which they are connected. An Edwards alarm system is used to sound a horn or ring a bell if the lubricating oil pressure fails or if the cooling water rises above a predetermined temperature. Every effort has been put forth to insure simple, safe, and economical operation of the plant.

Other features of the plant include the heating of the building by means of the warm engine jacket water. The water will be circulated through cast iron wall type radiators by means of a small centrifugal pump. The soft water will be used in the radiators as it is warmer than the raw water. Due to the many large windows in the building and the relatively low temperature of the water, as far as heating is concerned, a large number of radiators are required.

The municipal ownership of its utilities is not new to Hillsdale as they have been in the business for 46 years. This is, however, their first Diesel engine. It is anticipated that the economical performance of this first unit will result in the purchase of the second unit to occupy the space provided for it in the new building.

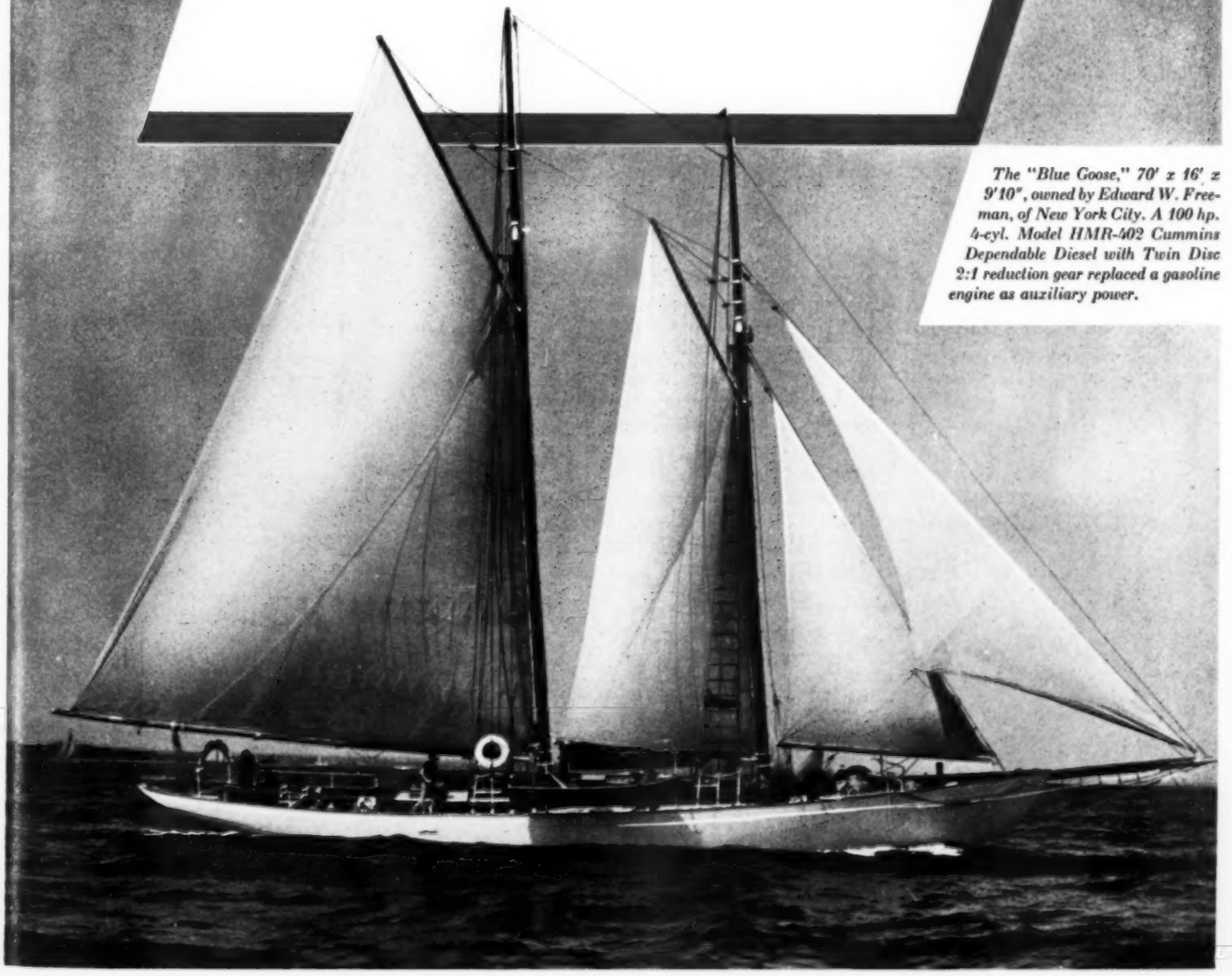
MR. R. K. MANGAN, Vice President of The Buda Company of Harvey, Illinois, has announced the appointment of Mr. Frank Flick as Marine Sales Manager.

Since 1931 Mr. Flick has been a distributor of various lines of marine hardware, accessories and engines. He has always covered the Central and Middle Western states with headquarters in Chicago. Prior to joining The Buda Company Sales Department in January, 1939, Mr. Flick served as the Buda distributor in Chicago for seven years.

Clear sailing ahead with CUMMINS Dependable DIESELS

There's an added thrill . . . the confidence of assured safety . . . when you have Cummins Diesel power in reserve. You know your Cummins Diesel is ready to deliver ample power for any emergency at the first touch of the throttle. No choking, priming or coaxing . . . no delays when you need instant power for safe and easy maneuvering in congested harbors.

The Cummins Diesel's extreme flexibility . . . quick acceleration . . . smooth running . . . these, too, add a lot to the pleasure of sailing. ¶ Whether it's auxiliary power or main propulsion, a Cummins Dependable Diesel will make your boat a better boat . . . a safer boat. Cummins Engine Company, 2516 Wilson Street, Columbus, Indiana.



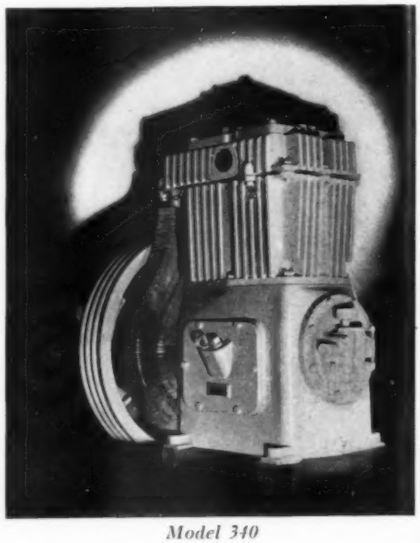
The "Blue Goose," 70' x 16' x 9'10", owned by Edward W. Freeman, of New York City. A 100 hp. 4-cyl. Model HMR-402 Cummins Dependable Diesel with Twin Disc 2:1 reduction gear replaced a gasoline engine as auxiliary power.

QUINCY EXTENDS LINE OF DIESEL-STARTING COMPRESSORS

A NEW and improved air compressor, designed for Diesel-starting service, is being currently announced by the Quincy Compressor Co. of Quincy, Illinois. According to J. T. Conder, Sales Manager of the Company, this new compressor features the new modern design and distinctive automotive-type mechanical improvements in a compressor size never before manufactured by Quincy.

This new Quincy Compressor, Model 340, is a two-stage vertical air compressor that is pressure lubricated. Model 340 is suitable for continuous pressures up to 200 lbs. with maximum intermittent pressures of 500 lbs. Maximum piston displacement 40 cu. ft. per minute; 5¼" low pressure bore, 3" high pressure bore by 3½" stroke. Special pressure lubrication on this new Quincy Compressor is provided by a gear type oil pump. This pump supplies a continuous spray of oil to connecting rod bearings and piston pins.

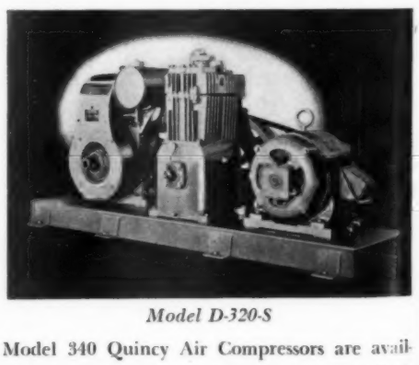
Among the many automotive-type features incorporated in this new Quincy Compressor are its nickel chrome alloy iron cylinders and head castings. The use of this metal makes these



Model 340

parts practically impervious to wear and the compressor is easily and quickly cooled at all times. Other automotive-type features include: Perfectly balanced crankshaft, Lynite connecting rods, large copper intercooler, semi-steel pistons and Timken Tapered Roller Bearings.

Quincy's Patented Loadless Starting is available on all automatic starting units. This device completely unloads the compressor whenever it stops, and by keeping it unloaded until motor reaches full load speed on the restart safeguards against burned out motors and belts. It also eliminates noisy check valves.



Model D-320-S

Model 340 Quincy Air Compressors are available in all types of mountings. DS Models have the compressor mounted on an extended base with both electric motor and gasoline engine. V-belt drive is interchangeable. Other types of mounting include electric motor or gasoline engine drive.

Anyone wishing further information regarding this compressor, please communicate with the Quincy Compressor Co., Quincy, Ill.

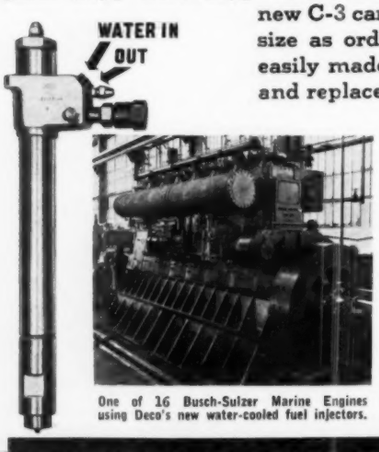
Now!

A COMPACT WATER-COOLED INJECTOR *Interchangeable with Standard Injectors*

Water jacket entirely surrounds needle valve seat and injector tip.

Engineers and Operators: Here's The Answer to Corrosion of Precision Parts and Carbon Formations On Injector Tips . . . Especially Adaptable to Marine, Pipeline and Stationary Installations.

NOW Deco makes available to you—for the first time—a compact, simple water-cooled fuel injector. Its use practically eliminates: (1) carbon formation on injector tips and (2) injector failures accelerated by corrosive fuels. Enables you to run for months without shutdowns—even on low-grade fuels. Handles crude fuels. Tests in heavy-duty engines, burning heavy bunker oils, show definite fuel savings. Adopted as standard in 16 Busch-Sulzer marine engines (20½" bore, 27½" stroke, 2-cycle) powering U. S. Maritime Commission's new C-3 cargo vessels. This water-cooled injector is same size as ordinary non-cooled injectors. Changeovers are easily made . . . you simply remove non-cooled injector and replace with Deco water-cooled injector. No changes in engine cylinder head design necessary. Only Deco offers you this money-saving interchangeability. Write today for complete details.



One of 16 Busch-Sulzer Marine Engines using Deco's new water-cooled fuel injectors.

If you have fuel injection and allied engineering problems, we invite you to consult with us. Deco research and testing laboratory contains complete facilities for stroboscopic analysis and dynamometer tests.

DIESEL EQUIPMENT CORPORATION

4401 NORTH RAVENSWOOD AVENUE., CHICAGO, ILLINOIS

DESIGNERS AND MANUFACTURERS OF FUEL INJECTION EQUIPMENT AND PRECISION PARTS

ORDERS!!!

HEREUNDER are listed a few of the marine Diesel engines which have been sold in the recent past by Fairbanks, Morse & Co.:

90 hp. Model 35 — For Captain Starret's freighter *Nereid*, Thomaston, Maine.

450 hp. Model 35 — For Tug owned by Chas. Zubik, Pittsburgh, Penna. (Conversion from steam).

300 hp. Model 35 — For tug owned by West Penn Sand & Gravel Company, Pittsburgh, Penna.

450 hp. Model 37 — For towboat owned by Igert, Inc., Paducah, Kentucky.

450 hp. Model 37 — For Tug owned by Becher Towing Company, Detroit, Michigan (Conversion from steam).

300 hp. Model 37 — For Tug owned by Florida Power Corp. (Conversion from steam).

Twin 600 hp. Model 37 — One 600 hp. Model 37 — For two towboats being built by Calumet Shipyard for John Hay.

Twin 575 hp. Model 37 — For new towboat being built by Calumet for Ashland Oil & Refining Company.

120 hp. Model 35 — For Yard tug of Bethlehem Shipbuilding Company.

300 hp. Model 37 — For new Menhaden Fishing boat being built by Standard Products Company.

805 hp. Model 37 — For tug owned by Gallagher Brothers Sand & Gravel Company (Conversion from steam).

805 hp. Model 37 — For new 100 ft. tug being built by Ira S. Bushey & Sons, Inc.

240 hp. Model 35 — For Tug *Elsie* owned by B. O. and W. W. Colonna, Norfolk, Virginia.

CUMMINS EXPANDS

CONTRACTS for the design and construction of a 10,000 square foot research and development laboratory for the Cummins Engine Company at Columbus, Indiana, have been awarded to The Austin Company, engineers and builders.

Planned to provide the finest testing and engineering facilities available in the Diesel industry, this structure will be of welded rigid frame construction. Special structural forms developed by Austin engineers for this project include a "whaleback" roof section, providing a 50-foot clear span entirely without web members. This section introduces monitor light and will be combined with "tree-form" columns in saw-tooth aisles to provide ideal daylighting conditions.

A machine shop, 50 feet by 100 feet, entirely without obstructions, will be provided. Special metallurgical and chemical laboratories are also included in the structure which will have a number of testing rooms for Diesel power units and parts. Forced ventilation will be provided throughout the structure, which is scheduled for completion shortly after the first of the year.

J. S. POLHEMUS . . . powered by
350 horsepower Enterprise Diesel

• So modern in design and so complete with equipment, the new dredge tender, J. S. POLHEMUS, is often referred to as the "one man boat" despite her 84-foot length. This model craft was designed by and built for the U. S. Engineers at the Seattle Shipbuilding and Drydock Corporation.

All of the Diesel power is provided by Enterprise engines, the main propulsion unit developing 350 horsepower, with an 80 horsepower engine for auxiliary service. The direct-reversing feature designed in the main engine, combined with other control devices, contributes much to the operating efficiency, maneuverability and safety of the POLHEMUS, and sets a new standard of performance for work boats of her type.

ENTERPRISE
ENGINE COMPANY

2902 Nineteenth Street • San Francisco, California

CITY OF WARREN
Warren, Ohio

Burgess Battery Co.
Chicago, Illinois

Last July we installed one of your SDH-5 exhaust snubbers on our air conveyor machine.

I feel it my duty to thank you and your company for making a snubber that really does the business. Our plant is situated on the Avenue which is quite unusual for a city water plant, and we had received many complaints of noise when we were unloading cars. Since this new snubber has been placed on the conveyor, no more complaints have been received and everyone seems to be happy.

I think you should be complimented on the output of such an efficient noise-eliminating article.

CITY OF WARREN WATER DEPT.
C. E. Inman, Supt.

"NO MORE COMPLAINTS about NOISE - - - everybody happy,"
says this satisfied user of a Burgess Snubber.

You, too, can operate Diesel engines, compressors, blowers, and vacuum pumps without troublesome noise. Burgess Snubbers "Snub the Slug" and prevent noise. The unrestricted passage through the Snubber eliminates peak back pressures. No tuning is required and high operating efficiency is maintained. Solve your noise problems with

BURGESS SNUBBERS
PATENTS APPLIED FOR

Burgess Battery Company
Acoustic Division, Dept. DPR
500 W. Huron St., Chicago
Operating under Burgess Patents

Send for FREE DATA BOOK
Gives complete information about noise problems. Mail coupon today.

Name.....
Company.....
Street.....
City.....State.....

IN tune with current railroad buying, the Chicago, Rock Island and Pacific Railway Company has placed orders for ten Diesel-electric switching locomotives, similar to the one illustrated. Five of these units are being constructed by the Davenport Besler Corporation of Davenport, Iowa, and five by the Baldwin Locomotive Works, of Philadelphia.

The locomotives are 44-ton, 360 hp. units, each powered by two 8-cylinder, V-type, 4-cycle Caterpillar Diesel engines. These are connected by two main generators provided with self-ventilation, the fans being built in at the ends opposite the commutators.

The 64 volt, 215 ampere hour capacity batteries are to be charged by a 3 kw. auxiliary generator at all speeds. Four traction motors are series wound, with a gearing 75/13 and are carried on the axle by bronze bearings, and on the trucks by springs.

The locomotives are to be 33 ft. long, weight 88,000 pounds on the drivers, and have a maximum operating speed of 30 miles per hour, with tractive capacity of 22,000 pounds. Water capacity is 50 gallons; lube oil capacity, 70 gallons; fuel oil capacity, 300 gallons.

The Rock Island Lines have two similar locomotives in service, which were constructed as a result of collaboration between engineers of the locomotive companies and the railway. The units are designed for switching service in small yards where the maintenance and expense of large locomotives are unwarranted.

CATERPILLAR 90-HP. TRUCK ENGINE

CATERPILLAR TRACTOR CO., one of the large manufacturers of Diesel engines, track-type tractors and road machinery, has announced its entry into the automotive field, with a 90 hp. Diesel truck engine.

WITTE DIESELECTRIC PLANTS

ASSURE BIG SAVINGS

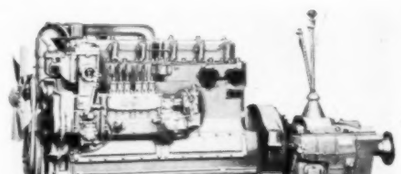
● These quality built, dependable economical Diesels lead the field today in delivering uninterrupted, low cost service. Usable wherever you need cheap power or light—produce the electricity you need for *less than ONE CENT a K.W.H.* Operate on cheap, non-explosive fuel. Assure low upkeep and efficient, constant low cost operation. Any employee can start them and keep them running without supervision.

Vertical and Horizontal—1500 to 8000 watts. Started manually, push button or fully automatic. $825 and up—f.o.b. K.C., Mo. Easy to buy — easy to pay for.

***WRITE* for complete details and "Pay - from - Savings Plan."**

WITTE ENGINE WORKS
2441 OAKLAND AVE. KANSAS CITY, MO.

For replacement installations, Caterpillar's Model D468 engine is offered as a complete unit, equipped with a five-speed Spicer No. 5351 transmission, and clutch.



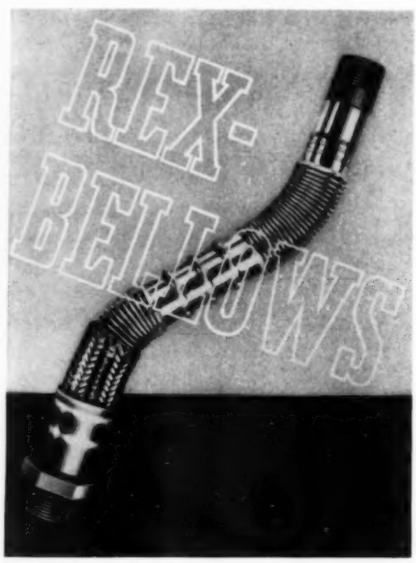
The engine is a six cylinder, four-stroke, valve-in-head, water-cooled model with a bore of 4¼ in. and a 5½ in. stroke. Maximum horsepower is developed at 1,800 rpm. Maximum torque is 305 pounds-feet at 900 rpm. Piston displacement is 468 cubic inches.

The engine fuel system features solid injection into precombustion chambers. All injection pumps and valves are set at the factory and require no adjustment in the field. Pistons are of aluminum alloy. The cylinder head, the block and the crankcase unit are in cast alloy iron. Water circulation is by pump, with the operating temperature of the water controlled by thermostat. There is an air-cooled type lubricating oil cooler provided. There are seven main crankshaft bearings,

with a total surface of 118 square inches. Connecting rod bearings are of 2⅝ in. diameter and are 1⅞ in. in length. There is a crankshaft torsional vibration damper. Lubrication is by pressure to all main and connecting rod bearings, piston pin bearings, camshaft bearings, valve operating mechanism and timing gears.

NEW DEVELOPMENT IN STAINLESS STEEL FLEXIBLE TUBING

ENGINEERING data of special interest to industrial concerns is contained in a new bulletin on Rex-Bellows, the "true bellows" 18-8 stainless steel flexible tubing. Both di-

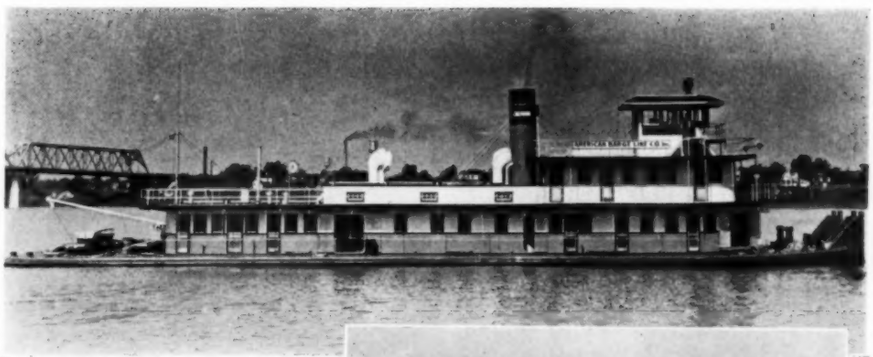


vided and fully corrugated forms are shown, together with couplings and the new pressure and vacuum tight joint secured by a process of electric resistance circumference seam welding which eliminates soldering and brazing. Ask for Bulletin SS-16, Chicago Metal Hose Corporation, Maywood, Illinois.

AUTOMATIC TRANSFER SWITCH

A NEW Automatic Transfer Switch, spring gravity drop-out type, for automatically connecting a lighting or power load to an emergency source in case of failure, is now being manufactured by the Zenith Electric Company.

The unit is available in one, two, three, or four pole construction, for A.C. to A.C., A.C. to D.C., D.C. to D.C., or D.C. to A.C. Current capacities range from 30 to 300 amperes. The switch will transfer when the voltage of the circuit drops to 70 per cent or less and will restore the load to the normal source when the voltage reaches 90 per cent.



"PATRIOT" and "PROGRESS"

Two new American Barge Line Co. Towboats Protected by ALNOR

RECENTLY built for the American Barge Line Company, Inc., under supervision of Mr. R. F. Brandt, Superintendent of its Transportation Division, the *Patriot* and *Progress* are two of the most powerful towboats plying inland waterways.

Identical in design, each boat is powered with two Cooper-Bessemer 8-cylinder Diesel Engines of 1,000 hp. rating at 300 rpm. Each of the four engines is protected by an 8-point Alnor Model RB Exhaust Pyrometer.

Frequent checking of individual cylinder performance, by means of the ruggedly built, dependable Alnor Pyrometers, insures highest operating efficiency, maximum power output, and thorough protection of these vital power plants.

The Alnor Catalog gives you complete information on Diesel pyrometers. A copy will be mailed to you upon request.

ILLINOIS TESTING LABORATORIES, Inc.
423 NORTH LaSALLE STREET • CHICAGO, ILLINOIS

"Alnor Pyrometers"—The ENGINE X-Ray

Protect . . .
your Diesel Investment!

Specify

MANZEL
FORCE FEED
LUBRICATORS
when ordering your new engine.

"Model 94"

● Manzel Force Feed Lubricators on your Diesels will assure you of positive, dependable lubrication throughout the life of the engines. And the consumption of lube oil will be surprisingly low.

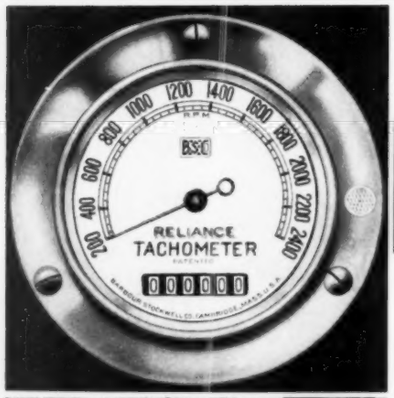
Manzel Lubricators deliver any desired quantity of oil to the cylinders or bearings in direct proportion to the speed of the engine. They meter out the lubricant in accurately measured quantities and deliver it to the point of lubrication with the same unfailing regularity with which it is measured out.

The Manzel oil-sealed pumping units insure positive delivery and prevent any air being drawn into the lines regardless of height of oil in the reservoir. All pumping units are interchangeable, and any pumping unit can be removed from lubricator for inspection or repair without stopping the lubricator or affecting other units.

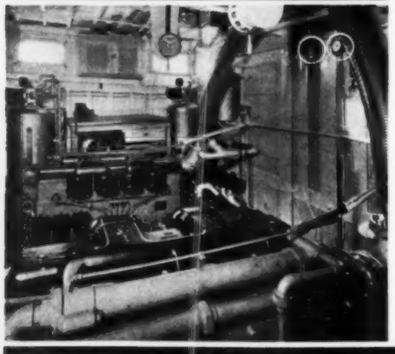
Manzel Lubricators are made with any required number of feeds; ratchet or rotary drive.

Write for Catalog 94-D

MANZEL BROTHERS CO.
275-277 BABCOCK ST. BUFFALO, N.Y.



New 90 foot MATHIS built yacht INNISFAIL—powered by two 170 H.P. SUPERIOR DIESELS—Reliance Equipped



Pre-eminent . . .

in the field of rotative speed indicating instruments for over twenty-five years, it was but natural that the Reliance Tachometer should become closely allied with the development of the Diesel Engine and the Accepted Standard of the Industry.

Noted for its Accuracy and ever dependable Performance year after year, without care or upkeep, you will find the Reliance Tachometer will meet your most exacting requirements.

Truly—"You Can Always Rely on Reliance"

BARBOUR STOCKWELL COMPANY
CAMBRIDGE, MASSACHUSETTS

RELIANCE TACHOMETERS
ACCURATE - DEPENDABLE - INDISPENSABLE

Contacts are copper to copper and they operate with a rolling and wiping action. Compression springs provide required contact pressure and permit quick opening. No neutral

New Automatic Transfer Switch

position is possible, 30 and 40 pole switches are protected on all phases with relays. Available for standard voltages 110 to 120 or 208 to 240 v., 25, 50, or 60 cycles, 115 or 230 v. D.C.

GLASS INSULATION IN DELCO-REMY REGULATORS

ONE of the newer applications of glass of particular interest to operators of motor coaches and trucks is the use by Delco-Remy of glass insulation in their line of heavy-duty generator

output regulators. The use of glass insulation is designed to provide added protection against failures resulting from chafing, heat and moisture, and thus insures longer and more trouble free operation of the regulator.

NEW HERCULES 2-CYLINDER DIESELS

HERCULES MOTORS CORPORATION of Canton, Ohio, following out its policy of making available the economies of Diesel operation to a constantly broadening field of industries, announces three new models of DIX Series two-cylinder, high-speed, heavy-duty Diesel Engines and Power Units.

This new two-cylinder Diesel incorporates several interesting new features and was designed for extreme simplicity, economy and reliability. The engine has the same bore and stroke and combustion system as the well-known Hercules DOO and DJX engines of which many thousands are in successful operation. The internal dimensions of the DIX Series of two-cylinder Hercules Diesels are as follows:

Model	*Bore*	*Stroke*	*Displacement*
DIXB	3¾"	4½"	99.4 cu. in.
DIXC	4	4½"	113.1 cu. in.
DIXD	4¼"	4½"	127.5 cu. in.

Model DIXB develops 24 hp. at 1,800 rpm. and has a maximum torque of 73 at 1,300 rpm. Model DIXC develops 27 hp. at 1,800 rpm. and has a maximum torque of 82 at 1,300 rpm. Model DIXD develops 27 hp. at 1,600 rpm. and has a maximum torque of 92 at 1,300 rpm.

FOR SALE

Pair right and left hand 200 H.P. 6 cyl. Winton Diesel engines, Model 138—8" bore, 10" stroke—direct reversible.

Auxiliary equipment includes:

1 5 H.P. 10 cu. ft. 2-stage air compressor
2 Main engine coolers
2 Starting air tanks—tested 400 lbs.
2 Oil strainers

HENRY C. GREBE & CO., INC.
3250 No. Washtenaw Avenue
CHICAGO, ILL.

FOR QUICK DISPOSAL

4—700 KW. Marine type Generators, 257 RPM., 240 v. for connecting to Diesel Engines. New, never installed, offered at great saving.

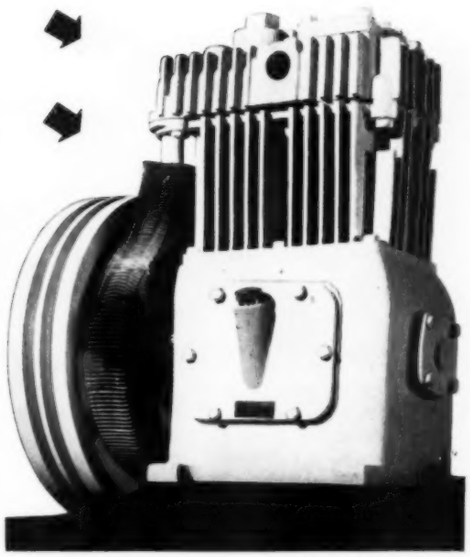
Also complete Engine Generator units A-1 condition.

STEPHEN A. DOUGLASS CO.
660 Fort Washington Ave. New York, N. Y.

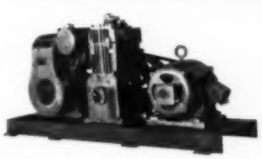
FAST
DEPENDABLE
DIESEL STARTING
with
Quincy
COMPRESSORS

***NEW* Quincy Design Acclaimed *by the* DIESEL INDUSTRY**

• New QUINCY COMPRESSORS are being furnished as standard equipment with Diesel engines made by several of the largest Diesel Engine manufacturers in the country. They have been installed in hundreds of the most modern up-to-date DIESEL Power plants. The new QUINCY COMPRESSORS are also standard equipment on many well-known makes of Diesel Auxiliary Units for Marine service. Designed for every starting service requiring intermittent pressures up to 500 lbs. per sq. in. All types of mountings.



ABOVE: Model 320 Quincy compressor.



LEFT: Model D-320-S Quincy compressor mounted on extended base with both electric motor and gasoline engine. Changeable V-belt drive.

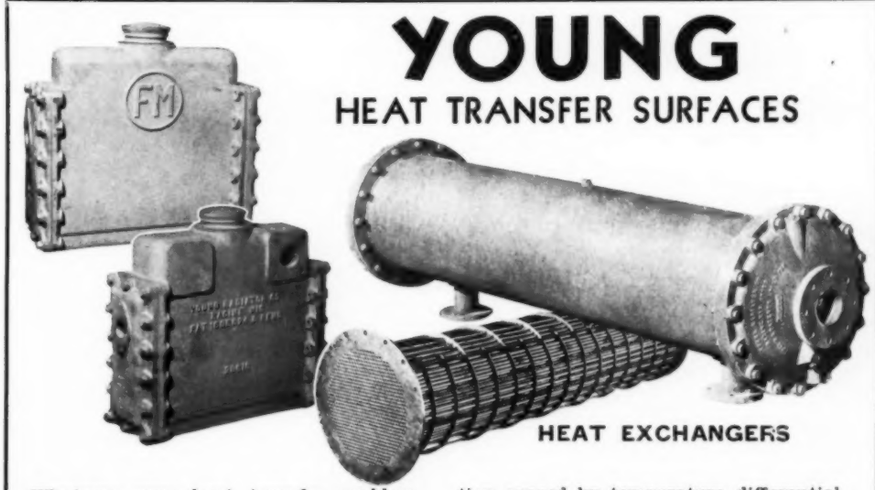
WRITE TODAY! for FREE New Catalog containing complete information on this new Quincy line for Diesel Starting.

Quincy Compressor Co.
410 Main St. Quincy, Illinois
Branch Offices:
New York Chicago San Francisco

***Only* QUINCY OFFERS ALL THESE FEATURES**

Timken Roller Bearings • Semi-Steel Pistons • Perfectly Balanced Crankshaft • Cushioned Steel Valves • Lynite Rods • Constant Level Oiling • Improved Cooling • Nickel Chrome Castings.

YOUNG
HEAT TRANSFER SURFACES



HEAT EXCHANGERS

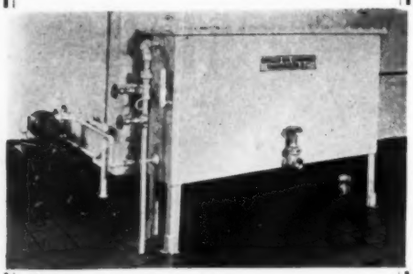
Whatever your heat transfer problem may be there is a Young unit to fit your requirements. Standard Young heat exchangers for liquid cooling are furnished with the proper design to meet requirements for various liquids such as oil, kerosene, water, etc., and are designed to meet all conditions of expansion and contraction caused by temperature differential. They are furnished in varying types to meet special conditions of space limitations or mounting. For use in connection with salt water special alloys to resist corrosive action are used. Regardless of what your problem may be Young engineers can provide a unit to meet your requirements.

Write for new descriptive catalogues

YOUNG RADIATOR COMPANY
Racine, Wisconsin

Young Quality

BRIGGS CLARIFIERS



BRIGGS CLARIFIERS . . . an outstanding success at Mt. Sinai Hospital, New York. A test run on the first unit installed brought a repeat order within six months.

Briggs Diesel lube oil Clarifiers are designed for use with the engine pumps, but can be successfully operated with an external auxiliary pump. You, too, can save money and maintenance troubles with Briggs Clarifiers.

For information, write to:

BRIGGS CLARIFIER COMPANY
3262 K STREET N. W.
WASHINGTON, D. C.

Remove Sludge from Oil Cooler Tube Bundles the Low-Cost Oakite Way

You can easily, quickly remove sludge from oil cooler tube bundles the safe, low-cost Oakite way. No fuss. No dismantling. Heat transfer efficiency speedily restored. Write for free data.

OAKITE PRODUCTS, INC.
22 Thames St., New York

OAKITE *Certified* **CLEANING**
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

JADSON

VALVES

Engineered for Diesels!

JADSON MOTOR PRODUCTS CO.
8354 WILCOX AVE. • BELL, CALIFORNIA

Latest Diesel Patents

A description of the outstanding patented inventions on Diesel and Diesel accessories as they are granted by the United States Patent Office. This information will be found a handy reference for inventors, engineers, designers and production men in establishing the dates of record, as well as describing the important Diesel inventions.

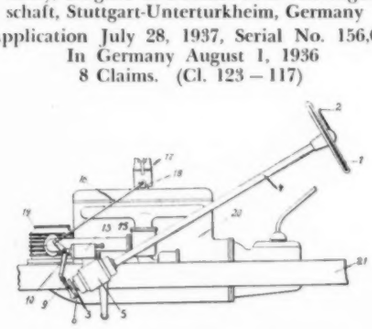
Conducted by C. CALVERT HINES*

2,166,525

INTERNAL COMBUSTION ENGINE

Albert Heess, Stuttgart-Bad-Cannstatt, Germany, assignor to Daimler-Benz Aktiengesellschaft, Stuttgart-Unterturkheim, Germany

Application July 28, 1937, Serial No. 156,083
In Germany August 1, 1936
8 Claims. (Cl. 123 – 117)



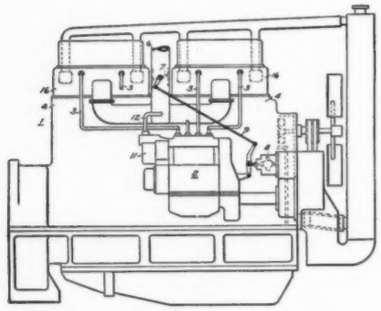
1. The combination comprising an internal combustion engine, a compressor cooperating therewith, an element for timing the ignition of said engine movable between an advanced position and a retarded position, a manually adjustable element connected with said first-mentioned element for manual control of the ignition, a member controlled by said compressor, and means connecting said member with said movable element and adapted to displace the latter towards its retarded position, when said compressor is active, irrespective of the position of said manually adjustable element.

2,165,176

INTERNAL COMBUSTION ENGINE

Nicholas Fodor, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis., a corporation of Delaware.

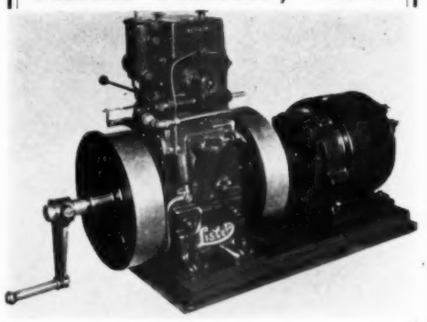
Application October 19, 1936, Serial No. 106,265
9 Claims. (Cl. 123 – 32)



1. The method of obtaining positive ignition and orderly burning at a rate insufficient to produce detonation in a low compression, solid injection engine having timed ignition and a charge forming chamber which comprises maintaining a portion of the charge confining surface of the chamber at an oil vaporizing

*Patent Attorney, 811 E Street, N.W., Washington, D.C.

LISTER DIESEL
Marine Auxiliary Units



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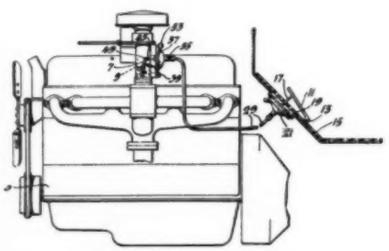
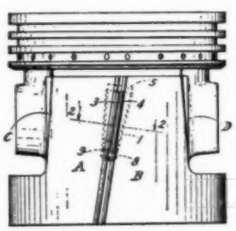
temperature and providing a confined atmosphere of air in contact with said surface, compressing the confined air to a pressure insufficient to produce self-ignition, spraying and distributing oil during the latter stages of the compression of the confined air and under all conditions of load and speed throughout the air confined within said chamber to form a uniform mixture, and when the spraying of oil ceases immediately initiating burning in that portion of the mixture in proximity to the vaporizing surface whereby the highly vaporized portion of the mixture in proximity to said surface is ignited before material movement or diffusion thereof and combustion progresses from the hotter and more highly vaporized to the cooler and less vaporized portions of the mixture.

2,164,475
HYDRAULIC THROTTLE CONTROL
Eric Olle Schjolin, Pontiac, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware.
Application May 22, 1937, Serial No. 144,251
2 Claims. (Cl. 74—513)



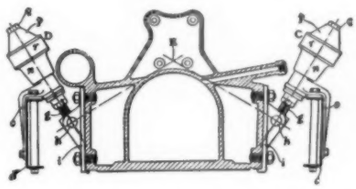
1. For use with an engine having a throttle valve, an actuating means to move said valve, a remotely positioned throttle valve operating member, fluid transmission means between said actuating means and said member, said transmission means including a conduit, a first chambered member at one end of the conduit, said chambered member having a closure diaphragm and a stem, the stem adapted to be connected to said actuating means, and a second chambered member at the other end of said conduit, said second chambered member being provided with a diaphragm and stem, the last named stem adapted to be moved by said member, the diaphragm of the first chambered member being more resistant to movement than the diaphragm of the second chambered member.

2,167,287
PISTON SKIRT EXPANDER
Leon A. Witter, Parma, Ohio
Application February 10, 1934, Serial No. 710,658
13 Claims. (Cl. 309 — 12)



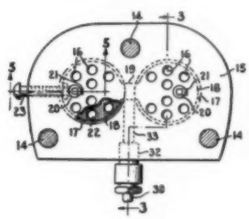
1. A piston skirt expander including a tapered sleeve member having a slot extending lengthwise thereof, said sleeve having lip portions adjacent said slot adapted to engage the edges of a slot in the skirt of a piston, a tapered plug fitting within said sleeve and means for drawing said plug into said sleeve to vary the width of said slot in said sleeve.

2,165,750
FLEXIBLE MOUNTING FOR INTERNAL COMBUSTION ENGINES
Joseph Hugh Stott Gardner and John Kynaston Gardner, Patricroft, near Manchester, England, assignors to L. Gardner & Sons Limited, Patricroft, near Manchester, England, a British company
Application July 23, 1937, Serial No. 155,348
In Great Britain October 16, 1936
3 Claims. (Cl. 248 — 7)



1. An engine mounting for a multi-cylinder internal combustion engine, comprising at least two bolts each pivotally secured to the engine, and disposed substantially tangential to a circle through the point of pivotal attachment of the bolt to the engine and having its centre on the natural axis of the engine, a collar upon said bolt axially adjustable therealong, a fixed point of support, a low rate compression coil spring surrounding said bolt and acting between said point of support and said collar, a part axially adjustable along said bolt and a high rate rubber buffer in fixed position so disposed as to be contacted by said part when said coil spring has been compressed beyond a predetermined amount.

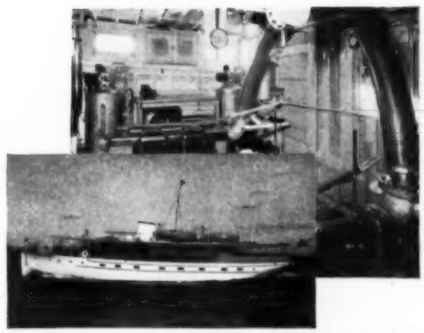
2,166,720
FUEL MIXING DEVICE
Alexander Gorleski, Leonia, N. J.
Application May 24, 1937, Serial No. 144,533
2 Claims. (Cl. 48 — 180)



1. A device of the character described comprising a body member adapted for attachment to an intake manifold, said body member having a central opening therein, a plate carried by said body member and having a plurality of perforations disposed above said central opening, a pair of discs disposed beneath said plate within said central opening, said discs being united for movement in unison and having a series of openings capable of alignment with the perforations in said plate, means for slidably connecting said discs with said plate, and means carried by said body member having engagement with one of said discs for adjusting said discs relative to said plate.

2,167,303
EXHAUST DEVICE FOR INTERNAL COMBUSTION ENGINES
Michel Kadenacy, Paris, France
Application August 31, 1935, Serial No. 38,826
In Great Britain August 31, 1934
2 Claims. (Cl. 60 — 32)

1. A two stroke cycle internal combustion engine wherein the burnt gases are discharged from the cylinder into an exhaust conduit substantially as a mass whereby the said mass moves outward and thereafter returns towards



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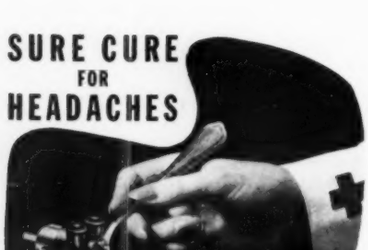

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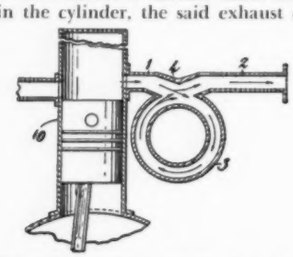
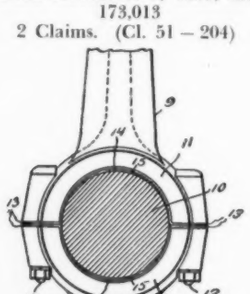
the cylinder from a point which may be within the said exhaust conduit, and wherein an inlet is opened for the introduction of fresh charge while the exhaust port is still open and when the said issuance of the burnt gases is in full progress and causes a suction effect to be exerted in the cylinder, the said exhaust conduit



providing a free passage for the burnt gases to the limit of outward travel of said mass and having a chamber in connection with said passage and wherein substantially the whole mass of burnt gases after leaving the cylinder is guided and is caused to adopt a whirling motion as a compact mass whereby the outward motion of the said mass is prolonged and the rebound of said mass towards the cylinder is delayed and reduced in intensity.

2,167,312
ABRADING ELEMENT
Frank Postma, Ridgewood, N. J.
Application November 5, 1937, Serial No. 173,013
2 Claims. (Cl. 51 – 204)



1. As a new article of manufacture, an abrading liner for abrading the journal of an engine crankshaft bearing, consisting of a pair of semi-cylindrical members adapted to be accommodated in the limited clearance space between the actual crankshaft bearing and the crankshaft journal of the engine and to seat against the bore of the bearing, each of said semi-cylindrical members being composed of a thin outer shell of relatively stiff and strong sheet material having granular abrading material bonded to its inner surface, the abrading material of each abrading liner member being of effective thickness intermediate the ends of its outer shell and gradually decreasing in thickness toward the ends of the latter.

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Foss Towing Company, Seattle, Washington – One DMQ-6, 750 hp. direct reversible engine, replacement of steam machinery in 110 ft. steel tug.

Martinolich Shipbuilding Company, Tacoma, Washington – One DMG-6 Special 600 hp. direct reversible engine for 90 ft. purse seine vessel.

Upper Columbia River Towing Company – One DMG-6 Special supercharged 1,000 hp. direct reversible engine for 65 ft. tug *Mystic*.

Eggers Transportation Company, Houston, Texas – One DMG-6, 350 hp. direct reversible engine for new steel tug.

Yuba Manufacturing Company – One DSG-8, 525 hp., 350 kw. Diesel generator set for gold dredge to be delivered to Livengood Placers Company, Fairbanks, Alaska.

U. S. Quartermasters Department, Fort Huachuca, Arizona – One DSQ-6, 750 hp. combination Diesel-Gas convertible engine for direct connection to 425 kw. generator and exciter.

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